higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T760**(E)**(J25)T

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

(8080602)

25 July 2018 (X-Paper)
09:00–12:00

This question paper consists of 5 pages and a formula sheet of 2 pages.

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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 sketches and diagrams must be in pencil.
5. ALL final answers must be rounded to THREE decimal places.
6 Write neatly and legibly.
7. Use π = 3,142

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QUESTION 1

Define the following electronics terms:

1.1. Impedance

1.2 Molecules

1.3 Volt

1.4 Root mean square(RMS)

1.5 Rectifier

(5 × 2) **[10]**

QUESTION 2

2.1 Which FOUR factors influence resistance? (4)

2.2 Refer to the circuit below and calculate the following:

2.2.1 Total resistance of the circuit (R_T) (6)

2.2.2 Currents I_1 and I_3 (6)

2.2.3 Voltage drop across R_4 if I_2 = 0,833 A (2)

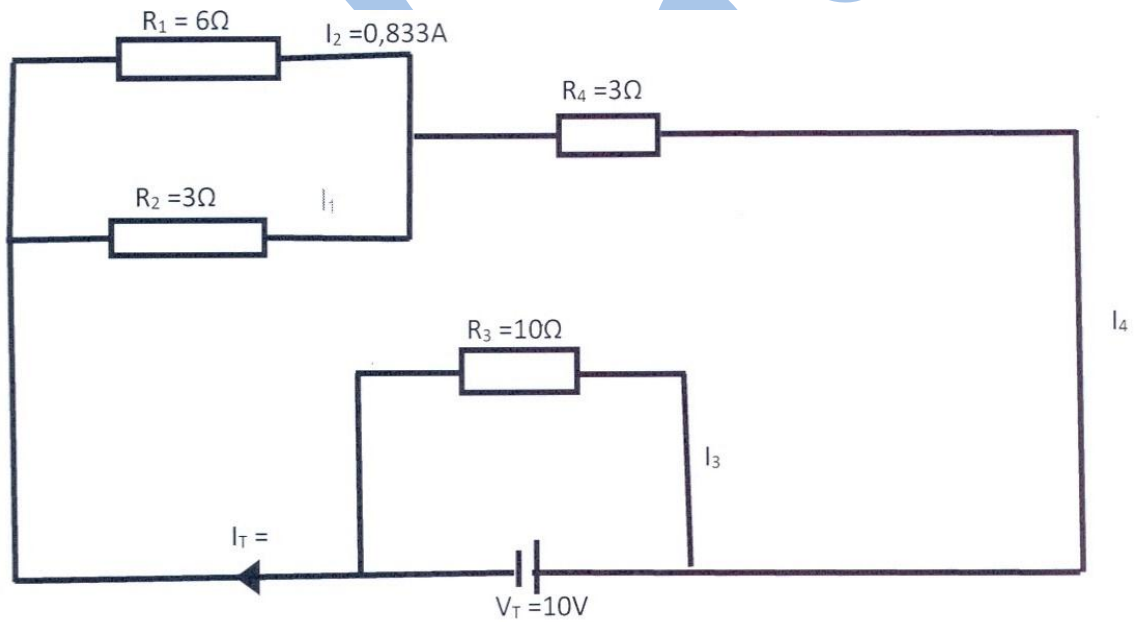

Figure1

[18]

QUESTION 3

A series circuit consists of a coil with an internal resistance of 50 Ω and an inductive reactance of 400 Ω. The circuit is connected to a capacitor with a capacitive reactance of 600 Ω. These two components are connected to a voltage source of 90 V with a frequency of 50 Hz.

3.1 Draw the circuit diagram of this combination and calculate the following:

3.1.1 Total current in the circuit (4)

3.1.2 Voltage drop across each component (6)

3.1.3 Phase angle (3)

3.1.4 Inductance of the coil and capacitance of the capacitor (4)

3.2 Draw the phasor diagram. (1)
[18]

QUESTION 4

4.1 With reference to Atomic Theory, what is the maximum number of electrons that may exist in each orbital. (4)

4.2 Name THREE impurities which have five valence electrons in the outer shell. (3)

4.3 Draw a fully labelled circuit diagram of a direct-current power supply using TWO diodes, a centre tap transformer and a filter capacitor. Clearly show the output wave before and after the capacitor. (8)
[15]

QUESTION 5

5.1 Show the difference between a PNP and an NPN transistor with the aid of a schematic diagram. (4)

5.2 Draw and discuss the basic operation of an NPN transistor using conventional current flow. (10)

5.3 Explain the following types of damping:

5.3.1 Mechanical damping

5.3.2 Electro-mechanical damping

(2 × 2) (4)
[18]

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QUESTION 6

6.1 The network below shows part of a transmission line.

Calculate input power (P_1) and the gain of amplifier (N_2) by using the given data.



(6)

Figure 2

6.2 Complete the following paragraph by choosing the correct word or words from those given in brackets Write only the word or words next to the question number (6.2.1–6.2.3) in the ANSWER BOOK.

Outside a magnet all magnetic flux lines leave the 6.2.1 (north pole/south pole) and enter the 6.2.2 (north pole/south pole). Inside a magnet all magnetic flux lines lie in a 6.2.3 (north-south direction/south-north) direction. (3 × 1) (3)

6.3 Copy the table below in the ANSWER BOOK and complete (6.3.1 – 6.3.5) by showing how the 240° phase shift is connected between the transmitter and the receiver of a synchro system.

TRANSMITTER	RECEIVER
R_1	6.3.1
R_2	6.3.2
S_1	6.3.3
S_2	6.3.4
S_3	6.3.5

(5 × 1) (5)
[14]

QUESTION 7

7.1 Thermocouples are temperature-sensitive devices that are manufactured from two electrical conductors made of two different metal alloys.

Name these TWO metal alloys. (2)

7.2 Draw a labelled construction of a thermocouple. (5)
[7]

TOTAL: 100

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INDUSTRIAL ELECTRONICS N2

FORMULA SHEET

DIRECT-CURRENT THEORY

$$V = I \cdot R \qquad P = V \cdot I \qquad P = \frac{V^2}{R}$$

$$P = I^2 \cdot R \qquad R_T = R_1 + R_2 \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2} \qquad I_1 = \frac{R_2}{R_1 + R_2} \times I_T$$

ALTERNATING-CURRENT THEORY

$$t = \frac{1}{f} \qquad e = E_m Sin\theta \qquad e = E_m Sin\omega t$$

$$e = E_m Sin2\pi ft \qquad i = I_m Sin\theta \qquad i = I_m Sin\omega t$$

$$V_{rms} = 0{,}707 V_{max} \qquad I_{rms} = 0{,}707 I_{max} \qquad V_{ave} = 0{,}637 V_{max}$$

$$I_{ave} = 0{,}637 I_{max} \qquad Form\ factor = \frac{rms\,value}{average\,value}$$

$$Crest\ factor = \frac{maximum\,value}{rms\,value}$$

$$E_{ave} = \frac{e_1 + e_2 + e_3 + e_4 + e_5 + ...e_n}{n} \qquad I_{ave} = \frac{i_1 + i_2 + i_3 + i_4 + i_5 + ...i_n}{n} \qquad \omega = 2\pi f$$

$$E_{rms} = \sqrt{\frac{e_1^2 + e_2^2 + e_3^2 + e_4^2 + e_5^2 + ...e_n^2}{n}} \qquad I_{rms} = \sqrt{\frac{i_1^2 + i_2^2 + i_3^2 + i_4^2 + i_5^2 + ...i_n^2}{n}}$$

$$X_L = 2\pi fL \qquad X_C = \frac{1}{2\pi fC} \qquad V = I \cdot R$$

$$V_T = \sqrt{V_R{}^2 + V_C{}^2} \qquad V_T = \sqrt{V_R{}^2 + V_L{}^2} \qquad V_T = \sqrt{V_R{}^2 + (V_L \sim V_C)^2}$$

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

$$I = \frac{V_T}{Z} \qquad I_R = \frac{V_T}{R} \qquad I_L = \frac{V_T}{X_L}$$

$$I_C = \frac{V_T}{X_C} \qquad I_T = \sqrt{I_R{}^2 + I_X{}^2} \qquad I_X = I_L \sim I_C$$

$$V_L = I \cdot X_L \qquad V_C = I \cdot X_C \qquad Z = \frac{V}{I_T}$$

$$\theta = \tan^{-1}\frac{I_X}{I_R} \qquad \theta = \cos^{-1}\frac{I_R}{I_T} \qquad \theta = \cos^{-1}\frac{R}{Z}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

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MEASURING INSTRUMENTS

$$R_{SH} = \frac{I_M R_M}{I_{SH}} \qquad R_S = \frac{V}{I_M} - R_M$$

TRANSISTORS:

$$I_E = I_C + I_B$$

DECIBEL RATIOS

$$N = 10 \log \frac{P_{OUT}}{P_{IN}} \qquad N = 20 \log \frac{I_{OUT}}{I_{IN}} + 10 \log \frac{R_{OUT}}{R_{IN}} \qquad N = 20 \log \frac{V_{OUT}}{V_{IN}} + 10 \log \frac{R_{IN}}{R_{OUT}}$$

If R_{IN}=R_{OUT}:

$$N = 20 \log \frac{V_{OUT}}{V_{IN}} \qquad N = 20 \log \frac{I_{OUT}}{I_{IN}}$$

RESISTANCE

$$R = \frac{\rho \ell}{A} \qquad A = \frac{\pi d}{4}$$

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