higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T630**(E)**(N18)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

(8080602)

18 November 2016 (X-Paper)
09:00–12:00

Nonprogrammable scientific calculators and drawing instruments may be used.

This question paper consists of 6 pages and 1 formula sheet of 2 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

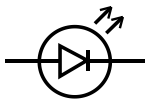
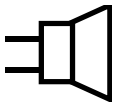
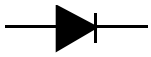
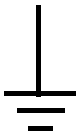
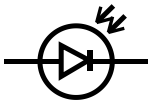
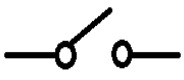
NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N2
TIME: 3 HOURS
MARKS: 100

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. Clearly show ALL calculations, diagrams, and graphs which you have used in determining the answers.
5. All diagrams and sketches must be neat and labelled.
6. If necessary, answers should be rounded off to THREE decimal places, unless stated otherwise.
7. Write neatly and legibly.

QUESTION 1

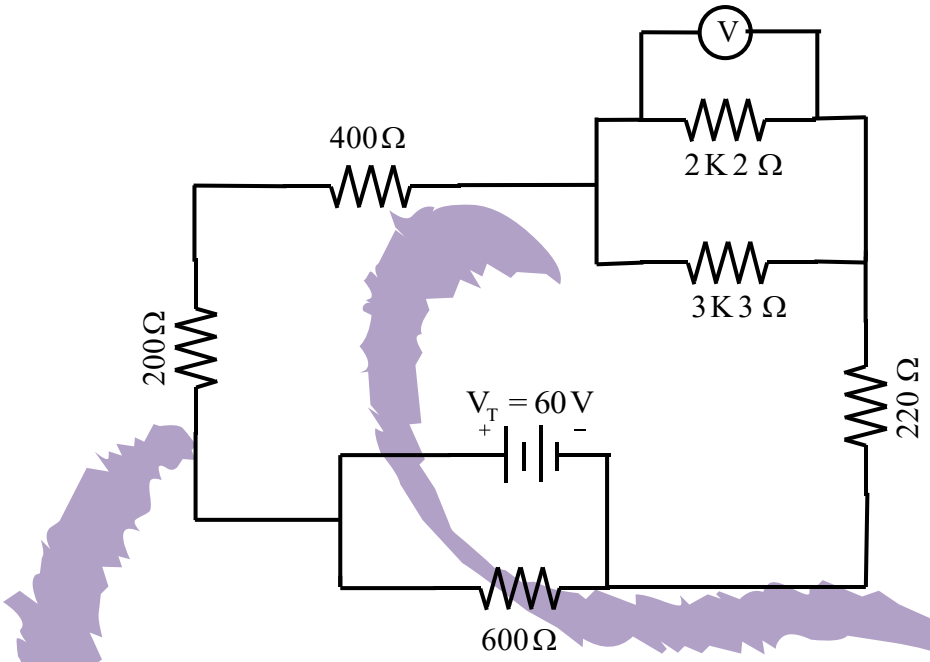
1.1 Choose an/a item/word from COLUMN B that matches an/a item/symbol in COLUMN A. Write only the letter (A–J) next to the question number (1.1.1–1.1.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1.1		A	zener diode
		B	light-emitting diode
1.1.2		C	voltmeter
		D	capacitor
1.1.3		E	battery
		F	loudspeaker
1.1.4		G	switch
1.1.5		H	diode
		I	photodiode
		J	ground/earth
1.1.6			
1.1.7			
1.1.8			
1.1.9			
1.1.10			

(10 × 1) **[10]**

QUESTION 2

The DC circuit below has a supply voltage of 60 V. A voltmeter is connected across the 2K2 Ω resistor.



Analyse the circuit and calculate the following:

2.1 The total resistance of the circuit (6)

2.2 The total current flowing in the circuit (2)

2.3 The voltage across the 2K2 Ω resistor (4)
[12]

QUESTION 3

A 20 Ω resistor , 200 µF capacitor and a 20 mH inductor are connected in series. The circuit is connected to a 100 V / 50 Hz supply.
Calculate the following:

3.1 The capacitive reactance (2)

3.2 The inductive reactance (2)

3.3 The impedance of the circuit (2)

3.4 The current flowing in the circuit (2)

3.5 The phase angle between the voltage and the current (2)

3.6 The voltage across the coil (3)

3.7 The resonant frequency (2)
[15]

QUESTION 4

The equation for a certain alternating wave is given by the formula:

$$e = 200 \sin (31,41\ t)\ V$$

Use the formula to calculate the following :

4.1 The maximum or the peak value of the voltage (2)

4.2 The average and the RMS values (2)

4.3 The form and the crest factors (2)

4.4 The frequency of the wave (2)

4.5 The instantaneous value of the voltage 6 milliseconds after zero (2)
[10]

QUESTION 5

5.1 With the aid of a neat circuit diagram, explain the concept of f*orward bias* as applicable to PN-junction diodes. (4)

5.2 Draw a labelled circuit diagram of a half-wave rectifier using a step-down transformer, a diode, a capacitor and a load resistor. The input and output waveforms must be shown. (6)
[10]

QUESTION 6

6.1 State TWO advantages of digital meters over analogue meters. (2)

6.2 An ammeter has a full-scale deflection current of 3 mA and an internal resistance of 50 Ω.

Calculate the following:

6.2.1 The shunt resistance to extend the meter range to 30 mA. (4)

6.2.2 The voltage to produce a full-scale reading for the basic meter movement. (2)

6.2.3 The multiplier resistor extending the full-scale meter reading to 12 V. (4)
[12]

QUESTION 7

7.1 Draw and label a single-stage NPN transistor amplifier in a common emitter configuration showing both the input and output waveforms. (6)

7.2 Name the THREE classes of amplifiers. (3)
[9]

QUESTION 8

8.1 Define *Lenz's law*. (3)

8.2 State TWO advantages of a synchro-system over a mechanical system. (2)

8.3 Draw a neat sketch showing the coupling between a transmitter and a receiver to give a 180^0 phase shift. (5)
[10]

QUESTION 9

9.1 Explain the operation of the following transducers:

9.1.1 Thermocouple

9.1.2 Bimetal strip

(2 × 3) (6)

9.2 Calculate the gain of an amplifier that produces a voltage of 12 V over a 20 Ω loudspeaker when a current of 14 mA is applied to the input.

The input impedance is 15 KΩ. (6)
[12]

TOTAL: 100

INDUSTIAL ELECTRONICS N2: FORMULA SHEET

DC THEORY

$$V = I \times R$$
$$R_T = R_1 + R_2$$
$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$P = V \times I$$
$$P = I^2 \times R$$
$$P = \frac{V^2}{R}$$

MEASURING INSTRUMENTS

$$R_{SH} = \frac{I_M \times R_M}{I_{SH}}$$
$$R_S = \frac{V_T}{I_M} - R_M$$

TRANSISTORS

$$I_e = I_c + I_b$$

DECIBEL RATIOS

$$N = 10\log\frac{P_{out}}{P_{in}}$$
$$N = 20\log\frac{I_{out}}{I_{in}} + 10\log\frac{R_{out}}{R_{in}}$$
$$N = 20\log\frac{V_{out}}{V_{in}} + 10\log\frac{R_{in}}{R_{out}}$$

If $R_{in} = R_{out}$

then $N = 20\log\frac{I_{out}}{I_{in}}$

and $N = 20\log\frac{V_{out}}{V_{in}}$

RESISTANCE

$$R = \frac{\rho l}{A}$$
$$A = \frac{\pi d^2}{4}$$

AC THEORY

$$t = \frac{1}{f}$$

$$e = E_m \sin 2\pi f t$$

$$i = I_m \sin 2\pi f t$$

$$\theta = 2\pi f t$$

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

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

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

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

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

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

$$\text{Form factor} = \frac{RMS \text{ value}}{AVE \text{ value}}$$

$$\text{Crest factor} = \frac{\text{Maximum value}}{RMS \text{ value}}$$

$$\omega = 2\pi f$$

$$X_C = \frac{1}{2\pi f C}$$

$$X_L = 2\pi f L$$

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

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

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

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

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

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

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

$$V_C = I_T \times X_C$$

$$V_R = I_T \times R$$

$$V_L = I_T \times X_L$$

$$\theta = \cos^{-1} \frac{R}{Z}$$

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