higher education
& training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T690**(E)**(N24)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N3

(8080613)

24 November 2015 (X-Paper)
9:00–12:00

Calculators may be used.

This question paper consists of 7 pages and 1 formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N3
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. Start each answer on a NEW page.
5. ALL the calculations must be shown.
6. ALL the final answers must be approximated accurately to THREE decimal places.
7. 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 (Aï C) next to the question number (1.1ï 1.15) in the ANSWER BOOK.

1.1 Kirchhoff's first law is applicable to:

A Series circuit
B Parallel circuit
C Series-Parallel circuit (1)

1.2 When measuring current, the ammeter must be connected in é

A series with the circuit closed.
B parallel with the circuit closed.
C series with the circuit open. (1)

1.3 What is the total current for a parallel RLC circuit when I_R = 3 mA, I_L = 5 mA and I_C = 2 mA and Z_T = 10 Ý?

A 4,243 mA
B 3,723 mA
C 2,125 mA (3)

1.4 Resonance can occur only in a circuit which contains é

A resistance and inductance.
B resistance, capacitance and inductance.
C resistance and capacitance. (2)

1.5 In an intrinsic semiconductor, the Fermi level is é

A closer to the valence band.
B midway between the conduction and valence bands.
C closer to the conduction band. (1)

1.6 A diode with a positive anode allows conventional current to flow é

A from cathode to anode.
B in both directions.
C from anode to cathode. (1)

1.7 For the varactor diode, the following is true:

A It can be used as a capacitor and is a forward-biased diode
B It can be used as a inductor and is a reverse-biased diode
C It can be used as a capacitor and is a reverse-biased diode (2)

1.8 In a class A amplifier, the output current flows for é

A a part of the cycle or the input signal.
B the full cycle of the input signal.
C half the cycle of the input signal. (1)

1.9 Negative feedback in an amplifier é

A increases its gain.
B reduces distortion.
C decreases its operating bandwidth. (1)

1.10 A bi-polar transistor is a:

A Voltage-controlled current device
B Current-controlled current device
C Current-controlled voltage device (2)

1.11 The operational amplifier of which the output signal is 0^0 phase shift with the input signal is called:

A Non-inverter
B Integrator
C Inverter (1)

1.12 Which ONE of the following statements of a summing operational amplifier is wrong?

A Its output waveform is in phase with the sum of the input voltages
B It is used to add several voltages together
C Its output waveform is the inverse of the sum of the input voltages (1)

1.13 Which one of the following transducers cannot be used for the measurement of pressure?

A Thermistor
B LVDT
C Potentiometer (1)

1.14 A zener diode can be used as é

A a switch.
B a clipper.
C a voltage reference source. (1)

1.1.5 The Schmitt trigger in a measuring instrument converts an analogue signal into a é

A triangular wave form.
B rectangular wave form.
C square wave form. (1)
[20]

QUESTION 2

Use Kirchhoff's method to determine the current flow (I_1ï I_2) in FIGURE 1 below.

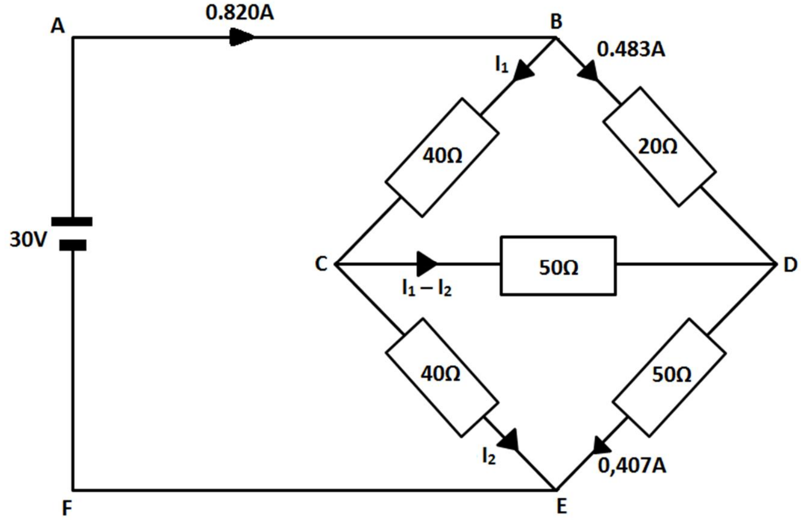

FIGURE 1 **[10]**

QUESTION 3

Consider FIGURE 2 below and answer the questions.

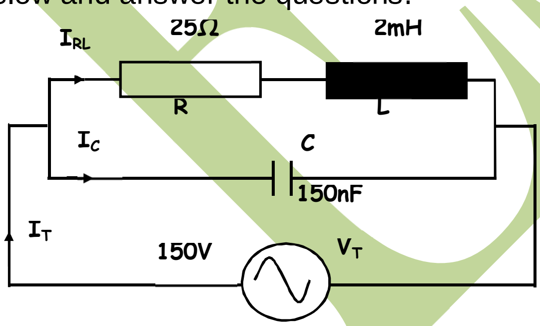

FIGURE 2

Calculate the following:

3.1 The resonance frequency (3)

3.2 The dynamic impedance (2)

3.3 The current at resonance (2)

3.4 Name THREE conditions of series resonance. (3)
[10]

QUESTION 4

4.1 Explain with the aid of the construction of a PN-junction diode what is meant by the following:

4.1.1 Forward bias

4.1.2 Reverse bias

(2 x 4) (8)

4.2 Give TWO applications of a light-emitting diode. (2)

[10]

QUESTION 5

5.1 Demonstrate, by means of neat, labelled diagrams the THREE different transistor configurations. (3 x 2) (6)

5.2 Explain the difference between positive and negative feedbacks in amplifiers. (2)

5.3 Name THREE advantages of negative feedback. (3)

5.4 Describe the operation of an n-channel JFET with the aid of its characteristic curve. (4)

[15]

QUESTION 6

6.1 Draw a transistor equivalent circuit of an SCR by means of TWO transistors. Also show the anode, cathode and the gate. (6)

6.2 Name TWO methods used to suppress transients. (2)

6.3 Name FOUR main characteristics of an operational amplifier. (4)

6.4 Draw a neat, labelled circuit diagram of a non-inverting operational amplifier. (3)

[15]

QUESTION 7

Refer to FIGURE 3 below and answer the questions.

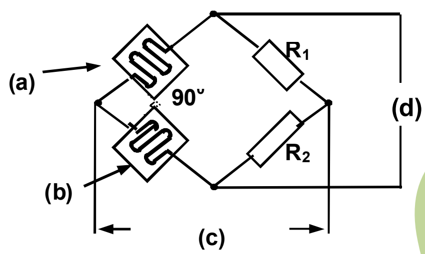

FIGURE 3

7.1	Identify the transducer.	(1)
7.2	Name the parts labelled (a) to (d).	(4)
7.3	Briefly explain the operating principle of the transducer.	(2)
7.4	Name THREE areas of its application.	(3) **[10]**

QUESTION 8

8.1	Name TWO examples of systematic errors.	(2)
8.2	Draw a labelled block diagram of a cathode ray oscilloscope.	(8) **[10]**

TOTAL: 100

INDUSTRIAL ELECTRONICS N3

FORMULA SHEET

Direct-current theory

$V = I \cdot R$

$P = V \cdot I$

$P = \frac{V^2}{R}$

$P = I^2 \cdot R$

Alternating current theory:

$X_L = 2\pi fL$

$X_C = \frac{1}{2\pi fC}$

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

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

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

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

$V = I \cdot R$

$V = I \cdot X_L$

$V = I \cdot X_C$

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

$I_R = \frac{V_T}{R}$

$I_L = \frac{V_T}{X_L}$

$I_C = \frac{V_T}{X_C}$

$I_T = \sqrt{I_R^2 + I_X^2}$

$I_X = I_L \sim I_C$

$\theta = \tan^{-1}\frac{I_X}{I_R}$

$\theta = \cos^{-1}\frac{I_R}{I_T}$

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

$Z_D = \frac{L}{RC}$

$I_T = \frac{V}{Z_D}$

$f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$

$I_C = I_{RL}\ Sin\theta_L$

$I_T = I_{RL}\ Cos\theta_L$

$I_T = \sqrt{{I_{T_H}}^2 + {I_{T_V}}^2}$

Transistors:

$I_C = \frac{V_{CC}}{R_L}$

Transducers:

$R = \frac{\rho \cdot l}{a}$

$C = \frac{k \cdot A \cdot E_o}{d}$