higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T700(E)(N24)T
NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N4

(8080164)

24 November 2014 (Y-Paper)
13:00–16:00

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

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N4
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 calculations must be shown.
6. ALL final answers must be approximated accurately to THREE decimal places.
7. Write neatly and legibly.

QUESTION 1

Use Thevenin's theorem to calculate the current flowing through the load resistor in FIGURE 1 below.

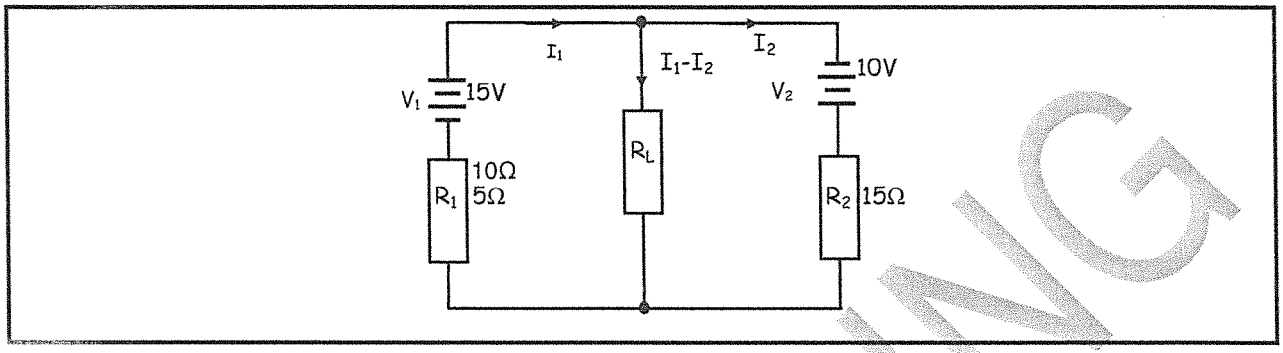

FIGURE 1 **[10]**

QUESTION 2

A circuit consists of TWO branches connected in parallel. A total voltage of $120\angle 10^0$ V is applied to this circuit. The current in the respective branches are $15\angle 20^0$ A and $20\angle 30^0$ A.

Calculate the following:

2.1 The total impedance of each branch (4)

2.2 The total impedance of the circuit (4)

2.3 The total current of the circuit (2)
[10]

QUESTION 3

3.1 Answer the following questions on the varactor diode:

3.1.1 State TWO of its uses. (2)

3.1.2 Draw its characteristic curve. (3)

3.1.3 Explain its operation. (2)

3.2

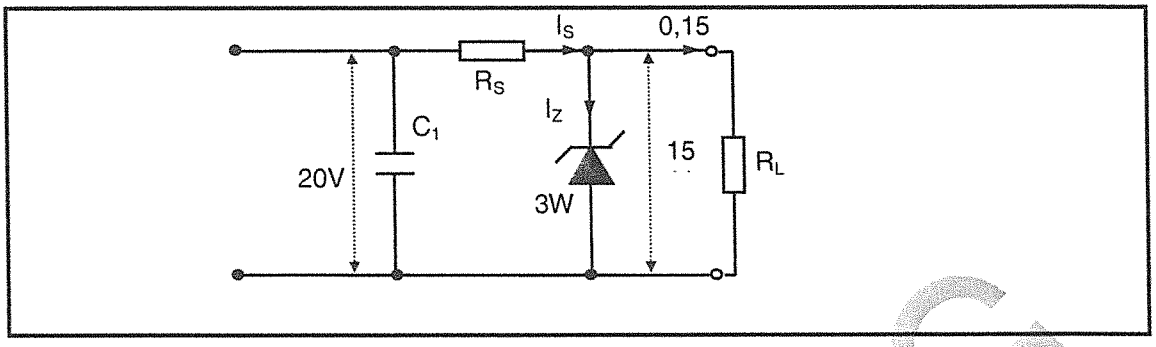

FIGURE 2

Consider FIGURE 2 above and calculate the following:

3.2.1 The value of the series resistor (Rs) (4)

3.2.2 The value of the load resistor (R_L) (2)

3.3 Give TWO disadvantages of a half-wave rectifier. (2)
[15]

QUESTION 4

4.1 Demonstrate, by means of neat, labelled diagrams the THREE different transistor configurations. (3 x 3) (9)

4.2 A common emitter amplifier produces an output voltage of 8 V with an input voltage of 6 V. The output current changes with 6 mA by means of 4 µA input current.

Calculate the following:

4.2.1 The input impedance

4.2.2 The forward-current gain

4.2.3 The output impedance

(3 x 2) (6)
[15]

QUESTION 5

5.1 Calculate the input resistance of a non-inverting amplifier if the following information is given:

- Input voltage = 2 V
- Output voltage = 5 V
- Feedback resistance = 2 kΩ (4)

5.2 Name FIVE characteristics of an ideal operational amplifier. (5)

5.3 Draw a neat, labelled circuit diagram of an operational amplifier connected as an inverter and calculate the output voltage if the following information is given:

- Feedback resistance = 1 kΩ
- Input voltage = 1 V
- Input resistance = 500 Ω (5)

5.4 An operational amplifier has the ability to handle both alternating-current and direct-current signals. (TRUE or FALSE) (1)
[15]

QUESTION 6

6.1 Demonstrate, with the aid of a labelled characteristic curve, the principle of operation of the following thyristors:

6.1.1 LASCR (3)

6.1.2 Triac (3)

6.2 Give THREE applications of an SCR. (3)

6.3 Draw a neat, labelled block diagram of a closed-loop motor speed-control system and explain the function of a comparator. (6)
[15]

QUESTION 7

7.1 What is the basic function of a potentiometer as a transducer? (2)

7.2 Draw and explain the operation of a transducer that is used to monitor the speed of rotation of a shaft. (8)
[10]

QUESTION 8

Choose a description from COLUMN B that matches an item in COLUMN A. Write only the letter (A–E) next to the question number (8.1–8.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
8.1	Power supply	A	produces two simultaneous output waveforms and applied to the horizontal plates
8.2	Function generator	B	supplies a saw tooth voltage to the horizontal deflection plates of a CRO
8.3	Time-base generator	C	consists of high voltage to operate the CRT and low voltage to supply the other electronic circuitry
8.4	Synchronisation	D	used to supply waveforms to test the operation of electronic circuits
8.5	Horizontal amplifier	E	causes the display to drift across the screen making measurement difficult

(5 x 2) **[10]**

TOTAL: 100

INDUSTRIAL ELECTRONICS N4

FORMULA SHEET

$$^{\circ}C = \frac{5}{9}(^{\circ}F - 32)$$

$$^{\circ}F = \left(^{\circ}C \times \frac{9}{5}\right) + 32$$

$$K = 273{,}15 + ^{\circ}C$$

$$W = \sigma T^4$$

$$W = \in \sigma T^4$$

$$W = \in \sigma\,(T_b^4 - T_a^4)$$

$$R_t = R_o\,(1 + \alpha t)$$

$$R_t = R_o\,(1 + \alpha t + \beta t^2)$$

$$I_s = \frac{1}{S} = \frac{V}{R} \rightarrow S = \frac{R}{V}$$

$$R_{sc} = \frac{V_{sc}}{I_s}$$

$$R_{cj} = R_o + \Delta R$$

$$R_z = \frac{V_{\min}}{I_s} + R_{cj}$$

$$R_s = \frac{R_{sw} \times R_t}{R_{sw} - R_t} \rightarrow R_t = \frac{V_{\max} - V_{\min}}{I_s}$$

$$R_u = \frac{V_{sc} - V_{\max}}{I_s}$$