



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N6

(8080186)

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09:00–12:00



This question paper consists of 5 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N6
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. Write neatly and legibly.
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QUESTION 1: TRANSIENTS

- 1.1 Answer the following questions regarding a ringing RLC circuit.
- 1.1.1 Define the concept *ringing* as applicable to an RLC circuit.  (1)
- 1.1.2 State ONE advantage and ONE disadvantage of the effect of resonance in a ringing circuit. (3)
- 1.2 State the differences between *overdamping* and *underdamping* in terms of each of the following:
- 1.2.1 Relationship between the terms under the square root sign
- 1.2.2 Circuit response speed (2 × 2) (4)
- 1.3  Draw a labelled current/time graph for a capacitor on the same set of axes during the charging and discharging cycles respectively. (2)
- 1.4 Draw a labelled current/time graph for an inductor on the same set of axes during the energising and the de-energising cycles respectively. (2)
- [12]**


QUESTION 2: TRANSDUCERS

- 2.1 Name the TWO typical categories into which instrumentation systems can be classified. (2)
- 2.2 Draw a fully labelled circuit diagram showing how a linear voltage divider network can be used to shift the reference level of a signal by a predictable amount.  (5)
- 2.3 Name the technique used in the circuit diagram in QUESTION 2.2. (1)
- 2.4 Indicate which of the following standard values are defined as a mark or a space in digital signals. Write only MARK or SPACE next to the question number (2.4.1–2.4.4) in the ANSWER BOOK.
- 2.4.1 +5 V
- 2.4.2 4 mA
- 2.4.3 20 mA
- 2.4.4 +1 V 
- (4 × 1) (4)
- [12]**

QUESTION 3: ULTRASONICS, X-RAYS AND RADIO ACTIVITY

- 3.1 Iron-cobalt and nickel alloys are two examples of magnetostrictive materials.
Briefly describe the term *magnetostriction*. (3)
- 3.2 An ultrasonic drill uses the technique of abrasion to machine hard and brittle materials.

Name THREE main components of which the ultrasonic drill circuit consists. (3)
- 3.3 The circuit diagrams of the ultrasonic welder and ultrasonic solder both consist of a feedback circuit.
Name the THREE components of this section. (3)
- 3.4 Describe each of the following in point form:
- 3.4.1 Physical construction of a basic proportional counter
- 3.4.2 Principle of operation of a Geiger-Muller counter (2 × 5) (10)
-  [19]

QUESTION 4: AUTOMATIC INSPECTION, TESTING AND NDT

- 4.1 X-ray tubes are used for nondestructive testing in industry.
Draw a neat, labelled circuit diagram which shows how the direct viewing method can be used to detect a flaw on a casting. (4)
- 4.2 Briefly describe point by point how the circuit diagram in QUESTION 4.1 operates in order to effect flaw detection on a casting. (4)
-  [8]

QUESTION 5: ELECTRONIC SAFETY DEVICES

Draw a neat, fully labelled circuit diagram of a basic flame failure detector circuit which is used for protection in industrial furnaces to stop fuel landing the hot hearth should the flame suddenly go out or fail to ignite. [11]

QUESTION 6: ELECTRONIC POWER CONTROL

6.1 The open-loop process control system uses a human operator to make changes or take corrective action during the manufacturing process.

Draw a neat, labelled block diagram of an open-loop system.



(4)

6.2 A desktop PC has to be installed. Which rating must the UPS system have that must be installed to power the PC in case of a power failure? The following data is available for the PC components:

- Tower-type computer case: 230 V 50/60 Hz 2 A
- Smart monitor: 230 V AC 60 Hz 1,5 A
- Inkunzi Printer: 220-230 V 60 Hz 0,3 A

Perform the necessary calculations to justify the ratings of the suitable UPS system.

(6)
[10]**QUESTION 7: THYRISTOR DEVICES AND SCR SPEED CONTROL**

7.1 In a three-phase bridge rectifier the load is fed via a three-phase half-wave connection and the neutral line is not required.

Draw a neat, fully labelled circuit diagram of a half-controlled three-phase bridge.

(8)

7.2 An SCR is used in power electronic equipment as a switch, which is either open or closed.



Give EIGHT ideal characteristics of an SCR as a switch.

(8)
[16]**QUESTION 8: PROGRAMMABLE LOGIC CONTROLLERS**

As senior programmable logic controller maintenance technician in a process control plant you have to make a presentation to a visiting class of elementary electronics juniors of what a PLC is and how it works.

8.1 Start the presentation by illustrating the relationship between the different functional components of a programmable logic controller (PLC) by setting up a neat, fully labelled block diagram that shows the components of the PLC.



(8)

8.2 Conclude the presentation by naming any TWO different types of engineering industries where practical applications of a PLC are used.

(4)
[12]**TOTAL: 100**