higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRONIC CONTROL AND DIGITAL ELECTRONICS
NQF LEVEL 3

(12041023)

10 December 2020 (Y-paper)
13:00–16:00

This question paper consists of 5 pages.

487Q1N2010

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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 section on a new page.
5. Use only a black or blue pen.
6. Write neatly and legibly.

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QUESTION 1

1.1 1.1.1 Name THREE types of waveforms that can be created by a function generator. (3)

1.1.2 Explain FIVE ways to take care of a function generator. (5)

1.2 1.2.1 Gallium has an atomic number of 31.

Show how its electrons are distributed within the shells K, L, M and N. (4)

1.2.2 How many valence electrons does gallium have? (1)

1.2.3 Explain why gallium is used in the doping process. (2)

1.3 Choose the correct term from those in brackets. Write only the answer next to the question number (1.3.1–1.3.5) in the ANSWER BOOK.

The tunnel diode has a 1.3.1 (heavily/lightly) doped junction. This creates a very 1.3.2 (narrow/wide) depletion region. Under 1.3.3 (forward/reverse) bias, electrons tunnel through the junction. The immediate forward bias allows its use in 1.3.4 (high/low) -speed switching devices. These components are commonly created using 1.3.5 (germanium/silicon). (5 × 1) (5)

1.4 Which of the leads of the transistor in the common collector configuration is used as the *input* and which is used as the *output*? (2)

1.5 A common collector circuit has operational currents I_B = 0,02 mA and I_E = 4 mA.

Calculate the current gain of this circuit. (3)

1.6 Indicate whether the following statements regarding a transistor series regulator circuit are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.6.1–1.6.5) in the ANSWER BOOK.

1.6.1 An NPN transistor is used in this circuit.

1.6.2 The Zener diode is configured at the collector of the transistor.

1.6.3 Excess voltage is dropped across the series resistor.

1.6.4 The Zener diode allows the base voltage to vary.

1.6.5 The output voltage across the load is $V_L = V_Z - V_{BE}$.

(5 × 1) (5)

1.7 1.7.1 Sketch the electronic symbol of an N-channel enhancement-type MOSFET. (2)

1.7.2 What would happen to the operation of this N-channel enhancement-type MOSFET if a positive voltage is biased at its gate? (3)

1.8 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–F) next to the question number (1.8.1–1.8.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.8.1	180° input to output phase shift	A	voltage summer
1.8.2	100% feedback $V_{out} = V_{in}$	B	integrator
1.8.3	Wave-shaping circuit	C	inverting amplifier
1.8.4	Multiple inputs added	D	voltage follower
1.8.5	Positive input used with feedback	E	differentiator
		F	noninverting

(5 × 1) (5)

[40]

QUESTION 2

2.1 Convert each of the following to the number system indicated:

2.1.1 $13,45_{10}$ to binary (4)

2.1.2 1101011101_2 to hexadecimal (3)

2.1.3 159_8 to decimal (3)

2.2 Use binary arithmetic to determine each of the following:

2.2.1 $10011_2 \times 101_2$

2.2.2 $101101_2 \div 1001_2$

2.2.3 $10111_2 + 1101_2 + 1011_2$

(3 × 3) (9)

2.3 Give TWO components or elements that all digital counters must have. (2)

2.4 Explain the operation of a four-bit asynchronous up counter. (4)

[25]

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QUESTION 3

3.1 Name the THREE main types of computer memory. (3)

3.2 Explain the term *hard disk*. (4)

3.3 List THREE ways in which a computer can indicate start-up errors. (3)

3.4 Explain how to ensure the correct replacement of the CPU IC. (5)
[15]

QUESTION 4

4.1 Define the term *transducer*. (2)

4.2 Explain the operating principle of a typical Wheatstone bridge. (5)

4.3 List THREE types of resistive transducers that can be configured to a Wheatstone bridge circuit. (3)
[10]

QUESTION 5

5.1 Give THREE advantages that PLCs have over older relay systems. (3)

5.2 Name TWO devices that can be used as input devices in a PLC system. (2)

5.3 Design a ladder diagram that allows TWO start switches (A and B) to be activated together so that a motor (C) starts to run continuously.

HINT: Use the AND configuration. (5)
[10]

TOTAL: 100

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