higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRONIC CONTROL AND DIGITAL ELECTRONICS
NQF LEVEL 3

(12041203)

2 March 2018 (X-Paper)
09:00–12:00

This question paper consists of 7 pages.

NCV

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.

NCV

QUESTION 1: FUNDAMENTALS OF ELECTRONICS

1.1 A technician uses measuring instruments for fault finding.

1.1.1 State how you would use a digital multimeter to measure current at a specific point in a circuit. (3)

1.1.2 An oscilloscope has a waveform displayed as a sine wave. The height from the 0 horizontal line to the positive peak shows 2,6 cm and the volt per division is set at 2 V per division.

Calculate the amplitude of the waveform. (2)

1.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

1.2.1 An atom with an atomic number of 13 has 8 electrons in its outer-most shell.

1.2.2 A charged atom is called an ion.

1.2.3 Electrons with the same energy levels exist in the same energy band.

1.2.4 There is mutual sharing of electrons in metallic bonding.

1.2.5 Donor doping creates an N-type material.

(5 × 1) (5)

1.3 Semiconductor diodes can be modified for different applications.

Indicate whether the following diodes operate in the FORWARD or REVERSE bias. Write only 'Forward' or Reverse' next to the question number (1.3.1–1.3.4) in the ANSWER BOOK.

1.3.1 Light-emitting diode

1.3.2 Tunnel diode

1.3.3 Varactor diode

1.3.4 Zener diode

(4 × 1) (4)

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1.4 Bipolar junction transistors can be configured to act as an electronic switch or as an amplifier.

1.4.1 Which configuration of an amplifier has high current and voltage gain? (1)

1.4.2 Draw a basic circuit diagram of a common-base configuration, indicating the input and output terminals. (3)

1.4.3 Write down the full meaning of the following as used on a transistor specification sheet:

(a) V_{CEO}

(b) h_{FE}

(2 × 1) (2)

1.5 Power supplies form part of most electronic applications.

1.5.1 Give ONE advantage of using a bridge rectifier circuit rather than a centre-tapped transformer circuit. (1)

1.5.2 Explain how a capacitor filter is used in a power supply that is trying to overcome pulsating DC voltage. (2)

1.5.3 Discuss how a transistor, a resistor and a zener diode are configured to form a transistor shunt-voltage regulator. (3)

1.6 Field-effect transistors are sensitive semiconductor components that have advantages over BJTs.

1.6.1 List THREE advantages that FETs have over BJTs. (3)

1.6.2 Name any FOUR precautions to consider when handling MOSFETs. (2 × 2) (4)

1.7 The operational amplifier IC can be used in many applications.

1.7.1 Draw and label the circuit symbol of an operational amplifier. (5)

1.7.2 Which input would be used in the circuit symbol in QUESTION 1.7.1 to create a summing operational amplifier circuit and what is the difference between the input and output signals? (2)

[40]

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QUESTION 2: DIGITAL ELECTRONICS

2.1 Convert the following numbers as indicated:

2.1.1 159_{10} to an octal number

2.1.2 110101100_2 to a hexadecimal number

2.1.3 $0{,}625_{10}$ to binary

(3 × 3) (9)

2.2 Divide the following binary numbers:

$10011_2 \div 101_2$ (3)

2.3 Subtract the following binary numbers:

$110{,}01_2 - 11{,}1_2$ (2)

2.4 Multiply the following binary numbers:

$1010_2 \times 101_2$ (2)

2.5 Digital counters can be configured to count up or down.

2.5.1 Design a block diagram of a three-bit asynchronous binary up-counter. (5)

2.5.2 Identify THREE characteristics of a synchronous counter. (3)

2.5.3 Is the bit element in FIGURE 1 below triggered by a negative or positive edge pulse?

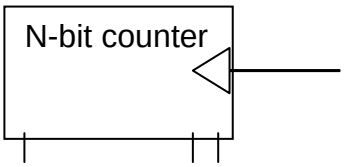

FIGURE 1 (1)

[25]

QUESTION 3: ASSEMBLING A PERSONAL COMPUTER

3.1 Identify the THREE main types of memory used in a computer and explain what each is used for. (3 × 2) (6)

3.2 A personal computer needs a TV module as an internal expansion card.

Explain step by step how you would install this card on the motherboard of an open tower. (4)

3.3 Choose an item from COLUMN B that matches the computer port in COLUMN A. Write only the letter (A–E) next to the question number (3.3.1–3.3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.3.1	VGA	A	printer
3.3.2	RJ-45	B	hard drive
3.3.3	PS/2	C	network
3.3.4	Serial	D	monitor
3.3.5	IDE	E	keyboard

(5 × 1) (5)

[15]

QUESTION 4: TRANSDUCERS

4.1 Resistive transducers use a Wheatstone bridge as a sensing circuit.

Study FIGURE 2 below and answer the questions.

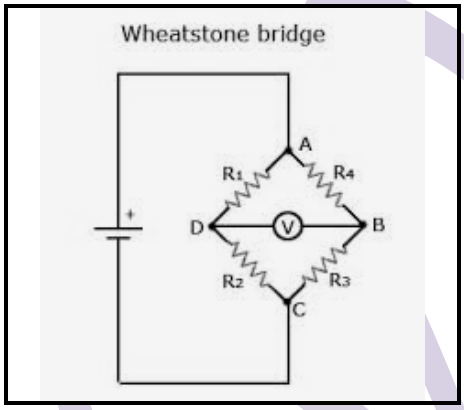

FIGURE 2

4.1.1 Explain the operation of the Wheatstone bridge by including a thermistor as part of the circuit to measure a change in temperature. (5)

4.1.2 What other resistive transducer can be attached to this circuit for measurements? (1)

4.2 What TWO nonelectrical values can be measured using inductive transducers? (2)

4.3 Describe the operation of a crystal oscillator. (2)
[10]

QUESTION 5: LADDER LOGIC – PROGRAMMABLE LOGIC CONTROLLERS

5.1 List the FIVE basic components that make up the block diagram of a PLC. (5)

5.2 An instrumentation technician has to be able to design ladder diagrams to solve problems.

Design a ladder diagram to control a motor. The motor has a two-push to make start switches that have to be on at the same time for the motor to run. The motor continues to run until a stop button is pushed. Label the diagram appropriately. (5)
[10]

TOTAL: 100

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