higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRONIC CONTROL AND DIGITAL ELECTRONICS
NQF LEVEL 3

(12041023)

8 November 2022 (X-paper)
09:00–12:00

This question paper consists of 6 pages.

149Q1N2208

Copyright reserved

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

Copyright reserved

QUESTION 1: FUNDAMENTALS OF ELECTRONICS

1.1 Complete the following sentences by writing the correct word that makes the statement true. Write only the word next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

When measuring current, an instrument called a (1.1.1 …) is used. The leads of the meter are connected in (1.1.2 …) to the circuit. The red and black leads ensure that one observes the correct (1.1.3 …). One should select the correct (1.1.4 …) on the meter to ensure that a true reading is displayed. The SI unit used to indicate current is (1.1.5 …). (5)

1.2 Function generators and oscilloscopes are typically used together.

Explain how one would use the two test instruments to find a fault in a circuit. (2)

1.3 Compare the following atomic terms by explaining the difference between each of the two.

Explain both terms.

1.3.1 Free electron and valence electron

1.3.2 Ionised atom and doped atom

1.3.3 Ionic bond and covalent bond

(3 × 2) (6)

1.4 1.4.1 Diodes are recognised by the alphanumeric code printed on them.

List TWO pieces of information or specifications that one would find in a data book of diodes.

1.4.2 LEDs have revolutionised the world.

What are TWO uses of LEDs?

(2 × 2) (4)

1.5 Complete the table below, explaining the operation of BJT transistors. Write only the answer next to the question number (1.5.1–1.5.3) in the ANSWER BOOK.

MODE OF OPERATION	EMITTER–BASE JUNCTION	APPLICATION
Linear	1.5.1	Amplifier
1.5.2	Forward	On switch
Cut-off	Reverse	1.5.3

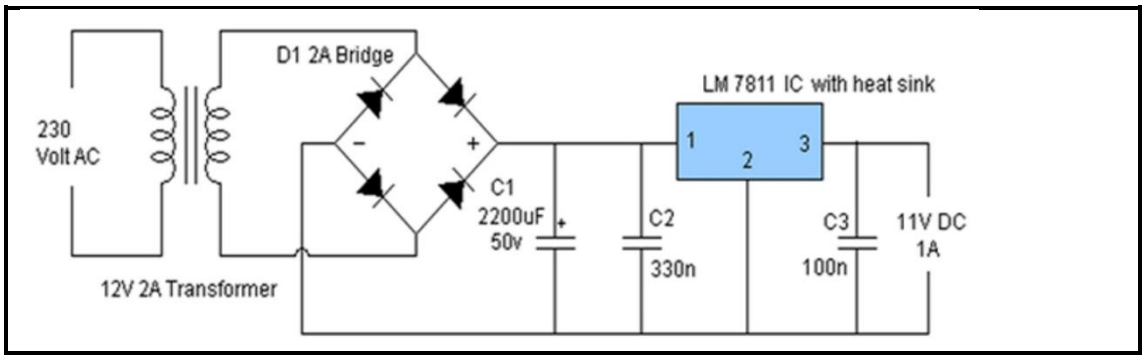
(3)

Copyright reserved

1.6 A BJT transistor is used as a common base amplifier having a collector current, I_C, of 4,5 mA and an emitter current, I_E, of 5 mA.

Calculate the current gain, α, for this circuit. (2)

1.7 Refer to the FIGURE below and answer the questions that follow.



Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (1.7.1–1.7.5) in the ANSWER BOOK.

1.7.1 The transformer is used to convert AC to DC.

1.7.2 The capacitor, C1, smooths out pulsating DC.

1.7.3 A set of two diodes are designed to allow each half cycle to flow.

1.7.4 The IC used in the circuit controls negative voltage.

1.7.5 Capacitors C2 and C3 are used to remove any ripple from the circuit.

(5 × 1) (5)

1.8 What other TWO types of Zener diode circuits can be used in this power supply to ensure that the output voltage remains constant? (2)

1.9 1.9.1 Identify TWO differences between *BJT* and *FET transistors*.

1.9.2 Draw the IEC symbol of an N-channel enhancement type MOSFET.

1.9.3 Explain why it is important to observe ESD safety when working with MOSFET transistor components.

(3 × 2) (6)

Copyright reserved

1.10 1. 10.1 Calculate the output voltage of a non-inverting operational amplifier with an input voltage of 2 V. Its feedback resistor, R_F = 20 kΩ and input resistor, R_{in} = 2 kΩ. (3)

1.10.2 What is the main difference between the *inverting* and *non-inverting op-amp* circuits with regard to the output phase of the signal?

(2)
[40]

QUESTION 2: DIGITAL ELECTRONICS

2.1 Number systems – conversions

2.1.1 Convert 11101010_2 to octal

2.1.2 Convert 110_{10} to hexadecimal

2.1.3 Convert 64_8 to decimal

(3 × 3) (9)

2.2 Binary arithmetic

2.2.1 Add $11110_2 + 10111_2$ (3)

2.2.2 Multiply $1101_2 \times 11_2$ (3)

2.2.3 Divide $11011_2 \div 100_2$ (4)

2.3 2.3.1 A synchronous decade counter has flip-flop bit elements connected in a specific way.

Explain the basic construction or configuration of this counter.

2.3.2 Draw the block diagram of 2 bit synchronous down counter.

(2 × 3) (6)
[25]

QUESTION 3: PERSONAL COMPUTERS

3.1 Explain THREE functions of the motherboard of a personal computer. (3)

3.2 List FOUR hardware items inside the tower and connected or mounted to the motherboard. (4)

3.3 You start up a computer and the tower LED lights up but there is no display on the monitor.

What steps would you take to troubleshoot a PC where the monitor does not come on? (3)

Copyright reserved

3.4 When setting up a new computer, external hardware connections are mounted to the back of the tower.

List FIVE types of ports used to connect the hardware. (5)

[15]

QUESTION 4: TRANSDUCERS

4.1 What TWO non-electrical quantities can capacitive transducers measure? (2)

4.2 Explain THREE factors that one would consider when designing a circuit using an inductive transducer. (3)

4.3 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–F) next to the question number (4.3.1–4.3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
4.3.1	Wheatstone bridge	A	thermistor
4.3.2	Temperature measurement	B	photosensitive transducer
4.3.3	Pressure measurement	C	resistive transducer
4.3.4	Magnetic field movement	D	hall effect
4.3.5	Light sending and receiving	E	inductive transducer
		F	bellow

(5 × 1) (5)

[10]

QUESTION 5: PROGRAMMABLE LOGIC CONTROLLERS (PLCs)

5.1 List THREE applications in industry where PLCs can be used. (3)

5.2 Memory is part of a PLC system.

Describe the part that the RAM or ROM plays in the process. (2)

5.3 Design a labelled ladder diagram that solves the following controlled process.

An operator presses a start button (X0) which runs a motor (Y0) of a lifting system. When the lift reaches a set height, a sensor (X1) stops the lift motor from running. (5)

[10]

TOTAL: 100

Copyright reserved