higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1

(8080641)

14 April 2021 (X-paper)
09:00–12:00

Nonprogrammable calculators and drawing instruments may be used.

This question paper consists of 7 pages and 1 formula sheet.

165Q1A2114

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N1
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

1.1 Draw a fully labelled sketch showing TWO bar magnets placed in such a way that the north poles face each other. Show the magnetic lines of force and their direction around each magnet. (6)

1.2 Name FOUR factors influencing resistance. (4)

1.3 Briefly explain *electromagnetic induction*. (4)

1.4 A relay is an example of an electromechanical switch.

Draw a fully labelled sketch of a relay, including the external contacts. (6)

1.5 Draw a circuit diagram of a bridge rectifier circuit showing all labels and waveforms on the diagram. (6)

[26]

QUESTION 2

2.1 Define each of the following terms regarding atomic theory:

2.1.1 Ion

2.1.2 Ionisation

2.1.3 Cation

2.1.4 Anion

2.1.5 Compound

(5 × 2) (10)

2.2 Draw THREE separate diagrams to indicate how the following measuring instruments are connected in a circuit:

2.2.1 Voltmeter

2.2.2 Ammeter

2.2.3 Ohmmeter

(3 × 2) (6)

2.3 Give FOUR examples of secondary cells. (4)

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2.4 A step-down transformer with a turn ratio of 10:1 is connected to a 250 V/50 Hz AC power supply. The current flow through the secondary winding is 5 A.

Determine each of the following:

2.4.1 Voltage across secondary winding

2.4.2 Current flow through primary winding

(2 × 2) (4)

2.5 Draw the IEC circuit symbols for each of the following:

2.5.1 Iron-core transformer

2.5.2 Iron-core inductor

2.5.3 Polarised capacitor

2.5.4 Rectifier diode

(4 × 1) (4)
[28]

QUESTION 3

3.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

3.1.1 Germanium has … valence electrons.

A four
B two
C sixteen
D eight

3.1.2 The value of potential difference across a cell is …

A a reading obtained when the circuit is open.
B slightly greater than the electromotive force.
C the same as the electromotive force.
D the value obtained when the circuit is closed.

3.1.3 A capacitor …

A blocks the flow of alternating current.
B blocks the flow of direct current.
C blocks both types of current.
D does not block direct current.

3.1.4 Holes are …

A negative charge carriers.
B only found around the junction of P-type and N-type materials.
C only found in N-type semiconductor materials.
D positive charge carriers.

3.1.5 The junction voltage across a silicon diode:

A 0,06 V
B 0,6 V
C 0,2 V
D 0,02 V

(5 × 1) (5)

3.2 Complete the following sentences by writing only the missing word or words next to the question number (3.2.1–3.2.5) in the ANSWER BOOK.

3.2.1 Magnetic lines of force move from … to … inside a bar magnet. (2)

3.2.2 A bipolar transistor can be used as a … .and as an … (2)

3.2.3 The anode of a diode is made from … semiconductor material. (1)

3.2.4 A Zener diode is normally used for …. (1)

3.2.5 The insulating material between the plates of a capacitor is referred to as a … (1)

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

COLUMN A		COLUMN B	
3.3.1	Flow from negative to positive	A	carbon-zinc cell
3.3.2	Stores electrical charge	B	holes
3.3.3	Allows current to flow in one direction only	C	capacitor
3.3.4	Provides larger currents	D	insulator
3.3.5	Does not allow current to flow	E	conductor
		F	transistor
		G	lead-acid battery
		H	electrons
		I	diode

(5 × 1) (5)

3.4 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.4.1–3.4.5) in the ANSWER BOOK.

3.4.1 A galvanometer can measure large currents.

3.4.2 Intrinsic semiconductor material is obtained after the process of doping.

3.4.3 Ohm's law gives the relationship between voltage, current and resistivity.

3.4.4 Electrons are placed in orbits around the nucleus of an atom using the formula $N = 2n^3$.

3.4.5 An atom is the smallest particle of a compound.

(5 × 1) (5)

3.5 Name the unit of measurement of each of the following quantities:

3.5.1 Capacitance

3.5.2 Battery capacity

3.5.3 Resistivity

(3 × 1) (3)

[25]

QUESTION 4

4.1 Three resistors with the following values are connected in series with each other to a 32 V direct-current power supply:

R_1 = 27 Ω (1%)
R_2 = 54 Ω (2%)
R_3 = 81 Ω (5%)

Determine each of the following:

4.1.1 Total resistance of circuit (3)

4.1.2 Current flow through the circuit (3)

4.1.3 Current flow through R_3 (1)

4.1.4 Colour code of R_1 (4)

4.2 Define *Lenz's Law.* (3)

4.3 List THREE factors that influence capacitance. (3)

4.4 Draw the charging curve of a capacitor. (2)

4.5 Draw the circuit symbol of a Zener diode and indicate the anode and cathode on the symbol. (2)

[21]

TOTAL: 100

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INDUSTRIAL ELECTRONICS N1

FORMULA SHEET

$$V = I \times R$$

$$P = \frac{V^2}{R}$$

$$P = I^2 R$$

$$P = V \times I$$

$$I = \frac{E}{R + r}$$

$$Q = C \times V$$

$$R = \frac{\rho \ell}{A}$$

$$R_t = R_o(1 + \alpha_o \Delta t)$$

$$R_t = R_1 + R_2 + R_3 ..... R_n$$

$$C_t = C_1 + C_2 + C_3 ..... C_n$$

$$L_t = L_1 + L_2 + L_3 ..... L_n$$

$$\frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} ..... \frac{1}{C_n}$$

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} ..... \frac{1}{R_n}$$

$$\frac{1}{L_t} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} ..... \frac{1}{L_n}$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p}$$

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