higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

INDUSTRIAL ELECTRONICS N1

(8080641)

1 April 2020 (X-paper)
09:00–12:00

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

044Q1A2001

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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 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 (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 The electrons of an atom …

A move around the nucleus in paths called ions.
B have a positive charge.
C are arranged in orbits around the nucleus and have no charge.
D are negatively charged particles that move in orbits around the nucleus.

1.1.2 Ohm's law about the relationship that exists between voltage, current and resistance states that …

A current is directly proportional to the resistance and inversely proportional to the voltage.
B resistance is inversely proportional to the current and directly proportional to the voltage.
C current is directly proportional to the voltage and inversely proportional to the temperature.
D current is directly proportional to the voltage and inversely proportional to the resistance.

1.1.3 Intrinsic semiconductor materials are …

A good conductors.
B poor insulators.
C neither good conductors nor good insulators.
D good conductors and insulators.

1.1.4 Polarisation occurs when …

A oxygen bubbles form around the carbon rod of a carbon/zinc cell.
B hydrogen bubbles form at the negative terminal of a cell.
C the electrolyte in a cell becomes dry.
D hydrogen bubbles form around the carbon rod.

1.1.5 An increase in electrical pressure at the terminals of an electrolytic capacitor will …

A increase the capacitance and decrease the charge.
B increase the charge.
C decrease the capacitance.
D destroy the capacitor.

(5 × 1) (5)

1.2 Complete the following sentences by writing down only the missing word or words next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

1.2.1 A transistor can be used as a fast-acting …

1.2.2 Diodes are constructed from P-type and N-type materials and have … junction.

1.2.3 An atom with an atomic number of ten has … free electrons.

1.2.4 Primary cells cannot be …

1.2.5 The plates of a capacitor are separated by an insulating material called the …

(5 × 1) (5)

1.3 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–I) next to the question number (1.3.1–1.3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.3.1	Doping refers to the addition of impurities to this material	A	hydrometer
1.3.2	Charges that flow from the negative terminal to the positive terminal of a cell	B	covalent bond
1.3.3	Used to measure specific gravity	C	repel
1.3.4	Bond between adjacent atoms in a crystal lattice structure	D	electrons
1.3.5	Like charges	E	ionic bond
		F	galvanometer
		G	intrinsic silicon
		H	attract
		I	extrinsic germanium

(5 × 1) (5)

1.4 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.4.1–1.4.5) in the ANSWER BOOK.

1.4.1 Secondary cells can be recharged.

1.4.2 The crystal lattice structure of germanium is similar to that of silicon.

1.4.3 Power is regarded as the ability to do work.

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1.4.4 A voltmeter is always connected in series in a closed circuit.

1.4.5 Like poles of a magnet are attracted to one another.

(5 × 1) (5)

1.5 Choose the correct word or words from those given in brackets. Write only the word or words next to the question number (1.5.1–1.5.5) in the ANSWER BOOK.

1.5.1 A capacitor blocks the flow of (direct/alternating) current.

1.5.2 A peak-to-peak value is (one/two/four) times the amplitude of a sine wave.

1.5.3 Magnetic lines of force move from the (north pole/south pole) to (south pole/north pole) outside a magnet.

1.5.4 A Zener diode can conduct when it is (forward biased/reverse biased/forward or reverse biased).

1.5.5 Transformers operate on the principle of (self-induction/magnetic induction/mutual induction).

(5 × 1) (5)
[25]

QUESTION 2

2.1 TWO resistors, R_1 = 1Ω2 and R_2 = 8Ω8, are connected in series with each other. These resistors are then connected to a parallel combination comprising R_3 = 3Ω3; R_4 = 1 kΩ and R_5 = 10 Ω. The complete circuit is then connected across a 50-V battery with an internal resistance of 1 Ω (1% tolerance).

2.1 Draw a circuit diagram representing the above information. (6)

2.2 Calculate the total resistance of the circuit (6)

2.3 Determine the current flow in the circuit. (3)

2.4 Calculate the power dissipated in the circuit. (3)

2.5 What is the colour code of the internal resistor? (4)

2.6 Calculate the voltage drop across the internal resistor. (3)
[25]

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QUESTION 3

3.1 THREE capacitors with the following values are connected in series across a 50-volt supply:

$C_1 = 5\mu F$; $C_2 = 15\mu F$ and $C_3 = 25\mu F$

Calculate the following:

3.1.1 Total capacitance of the circuit (4)

3.1.2 Charge developed across all the capacitors in the circuit (3)

3.2 A mains transformer has a turn's ratio of 5:1. When the primary winding is connected to the mains supply of 240 volts, a current of 1,0 ampere flows through the secondary winding.

Determine the following:

3.2.1 Voltage across the secondary winding (3)

3.2.2 Current flow through the primary winding (3)

3.3 State whether this circuit is a step-up or step-down transformer. (1)

3.4 Sketch the IEC circuit symbols for each of the following:

3.4.1 Carbon resistor

3.4.2 Potentiometer

3.4.3 Variable capacitor

3.4.4 Zener diode

3.4.5 PNP transistor

3.4.6 Battery with THREE cells

3.4.7 Rheostat

(7 × 1) (7)

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

3.5.1 Power

3.5.2 Battery capacity

3.5.3 Resistance

3.5.4 Potential difference

(4 × 1) (4)

[25]

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QUESTION 4

4.1 Define each of the following:

4.1.1 Polarisation (carbon-zinc cells)

4.1.2 Extrinsic semiconductor

4.1.3 Semiconductor

4.1.4 Ionic bond

4.1.5 Pentavalent

(5 × 2) (10)

4.2 FOUR cells, each with an emf of 1,5 volts and an internal resistance of 1,0 Ω are connected to one another in series. This battery is then connected across an external resistor with a value of 25 Ω.

Calculate the following:

4.2.1 Total emf of the battery

4.2.2 Total resistance of the circuit

4.2.3 Internal resistance of the battery

4.2.4 Current flow through the external resistor

4.2.5 Voltage drop across the external resistor

(5 × 2) (10)

4.3 State THREE advantages of secondary cells and TWO disadvantages of primary cells. (5)

[25]

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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