higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1

(8080641)

28 November 2017 (X-Paper)
09:00–12:00

This question paper consists of 6 pages and 1 formula sheet.

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. Keep subsections of questions together.
5. Use π as 3,142.
6. Answer each question on a NEW page.
7. Write neatly and legibly.

QUESTION 1

1.1 An atom consists of 29 electrons.

1.1.1 Calculate the number of electrons per major orbit using the correct formula. (4)

1.1.2 Draw a fully labelled sketch of this atom indicating ALL relevant information. (7)

1.2 Draw the IEC circuit symbols for each of the following components:

1.2.1 Preset resistor

1.2.2 Potentiometer

1.2.3 Air core inductor

1.2.4 Transformer

1.2.5 Varactor diode

1.2.6 Zener diode

(6 × 1) (6)

1.3 A copper conductor has a resistance of 48,6 Ω at a temperature of 20 °C.

Determine its resistance at zero degrees Celsius if its temperature coefficient of resistance is 0,0042 Ω/°C. (5)

1.4 A copper conductor has a length of 2 m and a resistivity of 0,018 µΩm.

Determine the resistance of the conductor if its cross-sectional area is $1{,}767 \times 10^{-6}$ m^2. (3)

[25]

QUESTION 2

2.1 Complete the following sentences by filling in the missing word or words. Write only the word or words next to the question number (2.1.1–2.1.10) in the ANSWER BOOK.

2.1.1 A diode will only conduct when it is … biased.

2.1.2 Silicon atoms have … valence electrons.

2.1.3 The majority charge carriers in P-type materials are called …

2.1.4 A transistor can be used as a high speed …

2.1.5 A … is a measuring instrument designed to measure very small amounts of current.

2.1.6 Pure silicon is referred to as … semiconductor material.

2.1.7 The plates of a capacitor are separated by an insulating material called a ...

2.1.8 The junction voltage of a germanium diode is approximately ... volts.

2.1.9 Different elements can combine to form a substance called a …

2.1.10 A hydrometer is used to measure the … of a cell.

(10 × 1) (10)

2.2 THREE resistors with values of 21 Ω, 44 Ω and 63 Ω respectively are connected to each other in parallel. This circuit is supplied by a 30 V DC power source.

2.2.1 Draw the circuit. (4)

2.2.2 Calculate the total resistance of the circuit. (3)

2.2.3 Determine the total current flow through the circuit. (3)

2.2.4 What is the voltage drop across the 63 Ω-resistor? (3)

2.2.5 Calculate the total power dissipated by the circuit. (3)

2.2.6 What is the colour code of the 21 Ω-resistor if it has a tolerance of 2%? (4)

[30]

QUESTION 3

3.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only TRUE or FALSE next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

3.1.1 A voltmeter is always connected in series in a circuit.

3.1.2 Doping is the addition of impurities to pure silicon.

3.1.3 Secondary cells cannot be recharged.

3.1.4 Transformers operate on the principle of mutual induction.

3.1.5 Frequency is measured in farads.

(5 × 1) (5)

3.2 A transformer has 200 turns of copper wire on the secondary coil which carries a current of 4 A. The supply voltage of 240 V causes a current of 1 A to flow through the primary coil.

Determine:

3.2.1 The number of turns on the primary coil

3.2.2 The voltage across the secondary coil

(2 × 4) (8)

3.3 Give THREE advantages of primary cells and THREE disadvantages of secondary cells. (3 + 3) (6)

3.4 Draw a fully labelled diagram of a full-wave rectifier circuit using a centre-tapped transformer. ALL waveforms, the load resistor and filter capacitor must be shown on the diagram. (7)

3.5 State the left-hand rule for electromagnetism. (4)

[30]

QUESTION 4

4.1 State THREE faults that can occur with transformers. (3)

4.2 Draw a fully labelled sketch showing TWO bar magnets with the north pole of one facing the south pole of the other. (4)

4.3 THREE identical cells with an internal resistance of 1 Ω and an emf of 2 V each are connected in series. A resistor with a value of 10 Ω is connected across this battery and a switch is connected in series with the entire circuit.

4.3.1 Draw a fully labelled sketch of the mentioned circuit. (4)

4.3.2 Calculate the current flow through the circuit when the switch is closed. (4)

[15]

TOTAL: 100

FORMULA SHEET

$$V = I \times R$$

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

$$P = I^2 R$$

$$P = V \times I$$

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

$$Q = C \times V$$

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

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

$$R_t = R_1 + R_2 + R_3 \ldots\ldots R_n$$

$$C_t = C_1 + C_2 + C_3 \ldots\ldots C_n$$

$$L_t = L_1 + L_2 + L_3 \ldots\ldots L_n$$

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

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

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

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