higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N2

(11041872)

1 December 2023 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 7 pages and formula sheet of 2 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
ELECTRICAL TRADE THEORY N2
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. Where applicable, answers must be in accordance with the SABS (SANS) code of practice, SANS 10142-1:2003 for the wiring of premises.
5. Sketches must be neat, labelled and large enough to show the required detail.
6. Write neatly and legibly.

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QUESTION 1: ALTERNATING CURRENT THEORY

1.1 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–G) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1.1	The ratio of true power to apparent power	A	maximum value
1.1.2	Smaller EMF values occurring at a specific instant occur before or after the maximum value	B	power factor
1.1.3	The value of an alternating current that produces the same amount of heat as its direct current equivalent	C	form factor
1.1.4	The ratio of the RMS value of a wave to its average value	D	instantaneous value
1.1.5	The highest or peak value of a wave	E	root mean square value
		F	average value
		G	mutually induced

(5 × 1) (5)

1.2 A single-phase motor is connected to a 230 V, 50 Hz supply and draws a current of 5,4 amperes at a power factor of 0,9 lagging.

Determine the following:

1.2.1 The true power of the motor (2)

1.2.2 The reactive power of the motor (3)

1.2.3 The apparent power of the motor (2)

[12]

QUESTION 2: CONDUCTORS, INSULATORS AND CABLES

2.1 Determine the maximum permissible fault current that a PVC insulated cable, which has aluminium conductors with a cross-sectional area of 16 mm^2 can carry for a maximum of 4 seconds. Take the conductor insulation factor as 62. (3)

2.2 List TWO uses of the following insulators:

2.2.1 Magnesium oxide

2.2.2 Bakelite

(2 × 2) (4)

2.3 Ceramic and porcelain insulators are glazed. What is the purpose of glazing? (2)

2.4 Name THREE advantages of a PVC-insulated wire-armoured cable. (3)

[12]

QUESTION 3: SWITCHGEAR AND PROTECTIVE DEVICES

3.1 Three-phase systems are protected against phase imbalances.

List TWO faults that can lead to an imbalance in a three-phase systems (2)

3.2 Explain the operation of the hydraulic magnetic type circuit breaker in the event of short circuit. (2)

3.3 List THREE causes of a high-voltage surge that may occur in over-head lines. (3)

3.4 Explain the purpose of an earth leakage relay. (3)

[10]

QUESTION 4: BATTERIES

4.1 State FOUR applications of gel batteries. (4)

4.2 State FIVE advantages of lithium-ion batteries. (5)

4.3 What is the recommended current of a gel battery during the bulk charging phase? (1)

[10]

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QUESTION 5: DC MACHINES

5.1 Interpoles are smaller poles that are located midway between field poles.

Briefly explain the purpose of interpoles. (2)

5.2 DC machines are named according to the method in which the field windings are connected relative to the armature.

List any TWO types of self-excited DC generators. (2)

5.3 Draw a neat labelled sketch of a simple two-pole DC machine and clearly indicate field winding, pole shoe, yoke, armature and pole core. (6)
[10]

QUESTION 6: AC MACHINES

6.1 Explain the purpose of the following tests in motors:

6.1.1 Earth continuity test

6.1.2 Insulation resistance test between windings and earth

(2 × 2) (4)

6.2 Draw a neat, fully labelled circuit diagram of a resistance-start induction-run single-phase motor. (4)
[8]

QUESTION 7: TRANSFORMERS

7.1 Draw a circuit diagram to show how three single-phase transformers are connected to form a three-phase star-star configuration. (5)

7.2 The no-load current drawn by a single-phase transformer is 4 A at a power factor of 0,55 lagging. Calculate the value of the magnetising current and the value of the core-loss current. (5)
[10]

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QUESTION 8: EARTHING

8.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (8.1.1–8.1.7) in the ANSWER BOOK.

8.1.1 A floating earth is when non-current carrying parts are joined together, forming a zero-volt potential point.

8.1.2 Portable electrical appliances, such as electric drills, are not required to be earthed if they meet the requirements for double insulation.

8.1.3 The voltage that prevents itself simultaneously across two accessible points during an insulation fault is referred to as a touch voltage.

8.1.4 Bonding to earth means electrically connecting to earth all current-carrying conductive parts of an electrical installation.

8.1.5 According to SANS regulation 5.1.3.1, a new installation shall be connected to the supply even though the supply does not include a protective conductor.

8.1.6 According to regulation 6.12.3.3, metallic frames and metallic enclosures of electrical equipment shall be made electrically continuous.

8.1.7 A protective conductor is a conductor provided for the purposes of safety and also connects the supply earth to the consumer's earth terminal.

(7 × 1) (7)

8.2 What does SANS 10142 regulation 5.1.3.3 stipulate with regards to earth leakage protection? (3)

[10]

QUESTION 9: MEASURING INSTRUMENTS

9.1 Explain what a galvanometer is. (2)

9.2 Explain how the range of a galvanometer can be extended. (1)

9.3 A moving coil instrument with an internal resistance of 10 ohms gives a full-scale deflection when a current of 0,05 A flows through it.

Calculate the value of the shunt resistance required in order for the instrument to give a full scale deflection with a current of 8 A. (3)

[6]

QUESTION 10: ELECTRICAL RETICULATION AND RENEWABLE ENERGY

10.1 Explain the following concepts:

10.1.1 Electrical reticulation network

10.1.2 Feeder

10.1.3 Renewable energy

(2 × 3) (6)

10.2 List TWO sources that are used to generate renewable energy. (2)

10.3 State FOUR advantages of the ring feeder system. (4)

[12]

TOTAL: 100

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ELECTRICAL TRADE THEORY N2

FORMULA SHEET

Any other applicable formula may also be used

AC THEORY

$e = Blv$

$e = e_{max} \sin\theta$

$i = i_{max} \sin\theta$

$T - \frac{1}{F}$

$E_{ave} = 0{,}637E_{max}$

$E_{rms} = 0{,}707E_{max}$

$Form\ factor = \frac{RMS\ Value}{Average\ Value}$

$Crest\ factor = \frac{Maximum\ Value}{RMS\ Value}$

$X_L = 2\pi FL$

$X_C = \frac{1}{2\pi FC}$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$I = \frac{V}{Z}$

$\cos\theta = \frac{R}{Z}$

STAR

$V_L = \sqrt{3}V_P$

$I_P = I_L$

DELTA

$V_L = V_P$

$I_L = \sqrt{3}I_P$

TRANSFORMER

$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1} = \frac{E_1}{E_2}$

SINGLE PHASE

$S = VI$

$P = VI\cos\theta$

$Q = VI\sin\theta$

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THREE PHASE

$$S = \sqrt{3} V_L I_L$$

$$P = \sqrt{3} V_L I_L \cos\theta$$

$$Q = \sqrt{3} V_L I_L \sin\theta$$

FAULT CURRENT

$$I_{fc} = \frac{CIF \times A}{\sqrt{t}}$$

SHUNT RESISTOR

$$R_{SH} = \frac{I_m R_m}{I_{SH}}$$

SERIES RESISTOR

$$R_{SE} = \frac{V}{I_m} - R_m$$

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