higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N2

(11041872)

24 November 2022 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

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

197Q1E2224

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. Answers must be given to THREE decimal places.
7. No marks will be allocated for incorrect SI units
8. Write neatly and legibly.

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QUESTION 1: ALTERNATING CURRENT CIRCUIT THEORY

1.1 Explain the following terms:

1.1.1 Self-induced emf

1.1.2 Mutually induced emf

(2 × 2) (4)

1.2 An alternating emf is represented by the following expression:

v = 360 sin (1 130,973t) V.

Determine the following:

1.2.1 The frequency of this emf. (2)

1.2.2 The RMS value of the emf (2)

1.2.3 The form factor. (4)

[12]

QUESTION 2: CONDUCTORS, INSULATORS AND CABLES

2.1 Complete the following sentences by choosing a word or words from the list below. Write only the answer next to the question number (2.1.1–2.1.2) in the ANSWER BOOK.

(**cable; earth continuity; tag washer; connection; stranded conductor; continuity conductor; tee-piece; gland; conductor; sheathing**)

With regard to joints and terminations in SANS 10142 regulation 6.3.7.2. Joints and terminations shall not

2.1.1 adversely affect current-carrying capacity, the insulation resistance or the … of the cable, core or conductor in which they are made.

2.1.2 be made in any connector, bend, elbow or … of a conduit.

(2 × 1) (2)

2.2 Mention TWO properties of a mica as an insulator. (2)

2.3 A single-phase circuit has a declared phase-to-neutral voltage of 240 V.

Calculate the minimum allowable voltage at any point of consumption. (3)

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2.4 Figure 1 below shows the basic construction of the XLPE-insulated cable. Identify the parts labelled (2.4.1 – 2.4.5).

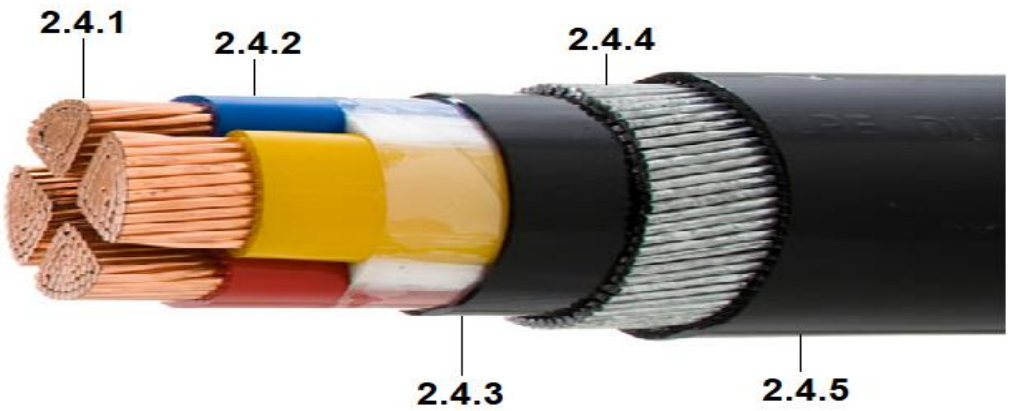

FIGURE 1

(5)
[12]

QUESTION 3: ELECTRICAL RETICULATION

3.1 State THREE advantages of a radial feeder system. (3)

3.2 Explain why are power stations situated far away from major load centres. (1)

3.3 State the typical voltage at each of the following sections of the reticulation network:

3.3.1 Generation

3.3.2 Transmission

3.3.3 Distribution

3.3.4 Utilisation

(4 × 1) (4)
[8]

QUESTION 4: SWITCHGEAR AND PROTECTIVE DEVICES

4.1 Redraw the table below and complete it by comparing the operation and application of a day-night-switch and a timer.

Switchgear	Operation	Application/ Uses
Day-night-switch		
Timer		

TABLE 1 (4)

4.2 Name the protective device used to protect against the harmful effect of the following faults:

4.2.1 Phase imbalance

4.2.2 Lighting discharges

(2 × 1) (2)

4.3 List any FOUR switchgears used for protection in electrical systems. (4)
[10]

QUESTION 5: BATTERIES

5.1 State FOUR disadvantages of lead-acid batteries. (4)

5.2 Briefly describe the construction of a lithium-ion battery. (4)

5.3 Mention TWO constant voltage charging methods used to charge gel batteries. (2)
[10]

QUESTION 6: DC MACHINES

6.1 Briefly explain the following terms as applicable to DC machines:

6.1.1 Armature reaction

6.1.2 Commutation

(2 × 2) (4)

6.2 State TWO methods that can be used to reduce the sparking between the commutator and brushes. (2)

6.3 Draw a neat, labelled circuit diagram of a series-wound DC generator. Clearly indicate the load and the direction of the current flow. (4)
[10]

QUESTION 7: AC MACHINES

7.1 State TWO applications of shaded-pole motors. (2)

7.2 With regards to a split-phase motor briefly describe each of the following:

7.2.1 Running winding

7.2.2 Auxiliary/starting winding

(2 × 2) (4)

7.3 With reference to single-phase motors, explain how the direction of rotation of a universal motor can be reversed. (2)

[8]

QUESTION 8: TRANSFORMERS

8.1 A single-phase transformer is connected to a 2 kV alternating current supply and draws a no-load current (I_0) of 2, 5 A at a power factor of 0, 2. Determine the following:

8.1.1 The magnetising component of the no-load current. (3)

8.1.2 The core-loss component of the no-load current. (2)

8.2 Briefly explain the operation of a single-phase transformer at no-load. (5)

[10]

QUESTION 9: EARTHING

9.1 With reference to SANS regulations regarding the use of earth continuity conductors, indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (9.1.1–9.1.6) in the ANSWER BOOK.

9.1.1 Earth continuity conductors shall be so arranged that they cannot be tampered with.

9.1.2 An earth continuity conductor may have branch circuits provided its resistance complies with table 8.2.

9.1.3 A fuse or switching device shall be fitted in an earth continuity conductor.

9.1.4 An earth continuity conductor shall not be used to carry any current other than fault currents.

9.1.5 Earth continuity conductors shall be suitably protected against all forms of damage.

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9.1.6 A wire way shall not be used as an earth continuity conductor.
(6 × 1) (6)

9.2 Answer the following questions regarding a floating earth in appliances:

9.2.1 Explain the term, *floating earth*. (2)

9.2.2 Name TWO appliances where a floating earth is found. (2)
[10]

QUESTION 10: MEASURING INSTRUMENTS

10.1 A moving coil instrument having an internal resistance of 10 Ω, gives full-scale deflection when 10 mA passes through it. Calculate the value of a resistor to be used with the instrument so that it can measure a current of 1 A. (3)

10.2 With the aid of a labelled diagram, show how an ammeter can be connected in a low-voltage circuit to measure the current flowing in it. (3)
[6]

QUESTION 11: RENEWABLE ENERGY

11.1 Explain the difference between renewable energy and non-renewable energy. (2)

11.2 Name any TWO types of renewable energy sources. (2)
[4]

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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