higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T440**(E)**(N12)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N2

(11041872)

12 November 2014 (Y-Paper)
13:00–16:00

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

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. Formulae used in Electrical Trade Theory N2 can be found at the end of the question paper.
6. Answers must be given to TWO decimal places.
7. Write neatly and legibly.

QUESTION 1: CONDUCTORS AND CABLES

1.1 Name THREE variables to consider when selecting the cable for a specific application. (3)

1.2 Name THREE advantages of installing high-voltage cables by suspending them in the open air. (3)

1.3 A 220 V single-phase inductive load uses 20 kW at a lagging power factor of 0,8.

Calculate the full load current that flows through the supply cable. (3)

1.4 Explain the term *armoured cable*. (2)

[11]

QUESTION 2: SWITCHGEAR, CONTACTORS AND RELAYS

2.1 Compare disconnectors and circuit breakers under the headings below. Present your answer in table format.

2.1.1 Function

2.1.2 Operation

(2 x 2) (4)

2.2 Explain how single-phasing is prevented when a 3-phase circuit breaker trips. (2)

2.3 A circuit breaker has an inverse time delay. Explain this terminology. (2)

2.4 When a breaker begins to open, the current could still flow as a result of arcing.

Name THREE measures manufacturers use to minimize the destructive power of the arc. (3)

2.5 State how the geyser sub-circuit is identified the distribution board. (1)

[12]

QUESTION 3: DC MOTORS AND STARTERS

3.1 Explain the function of the following protective devices used in DC motor starters:

3.1.1 Overload relay

3.1.2 No-volt release coil

3.1.3 Starting resistors

(3 x 2) (6)

3.2 Draw a neat, fully labelled circuit diagram of a short shunt compound DC motor. (4)

3.3 Name TWO methods of reversing the direction of rotation of a series motor. (2)

[12]

QUESTION 4: AC MOTORS AND STARTERS

4.1 The universal series motor is widely used for small AC applications.

4.1.1 Explain how it operates with an AC supply. (2)

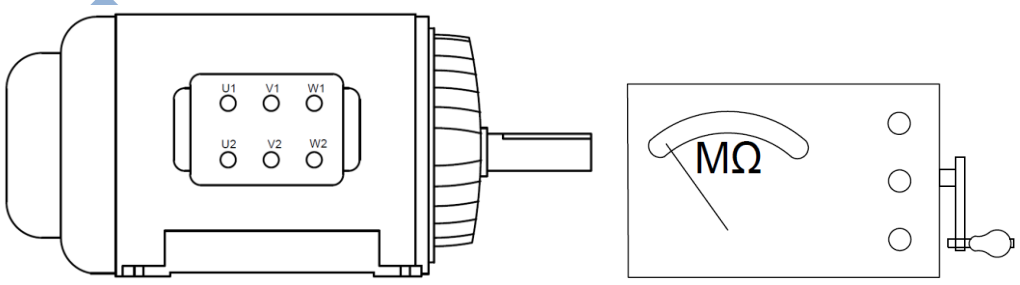
4.1.2 Name TWO appliances using universal motors. (2)

4.2 Name TWO types of induction motors. (2)

4.3 Explain how current flow is established in the rotor bars of an induction type squirrel cage motor. (3)

4.4 Large induction motors need starters to limit the starting current. State the type of starter that should be used with a large squirrel-cage induction motor. (2)

4.5 Figure 4.1 shows an electric motor and insulation tester. Describe, with the aid of drawings, how to test the insulation resistance between the windings. The explanation should include approximate values expected during the test.



(4)

FIGURE 4.1: INSULATION RESISTANCE TESTING OF A MOTOR **[15]**

QUESTION 5: EARTHING

5.1 Between supplier and consumer, the ground is being used as the earth-continuity conductor.

5.1.1 State which conductors on the supplier's side are connected to earth. (1)

5.1.2 State which conductors on the consumer's side are connected to earth. (1)

5.2 Explain the purpose of earthing of an electrical installation. (2)

5.3 Give a definition of the '*consumer's earth terminal*'. (1)

5.4 Name THREE protective measures that will protect people, animals and property from harmful earth fault currents. (3)

5.5 An outdoor substation contains overhead conductors, switch disconnectors, surge arrestors, overload protection, star-delta transformers, etcetera.

Explain how the following are earthed:

5.5.1 All equipment earthing points, metal tanks, metal support structures (2)

5.5.2 The overhead earth wires stretching above the substation (2)

[12]

QUESTION 6: PROTECTION

6.1 State the purpose of an earth-leakage protection device (2)

6.2 Explain where the earth leakage relay must be installed in a domestic electrical installation. (2)

6.3 Refer to FIGURE 6.1. Identify the conductors that should pass through the core of the toroid transformer inside a three-phase core balance earth leakage relay.

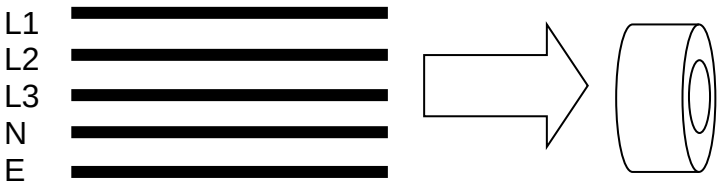


FIGURE 6.1: THREE PHASE BALANCED CORE EARTH LEAKAGE (1)

6.4 Explain the term '*phase imbalance*' with reference to three phase mains supply. (2)

6.5 Make a sketch to show a single-phase installation can be protected against voltage surges using low-voltage surge protectors. (3)

[10]

QUESTION 7: MEASURING INSTRUMENTS

Measuring instruments are important for circuit diagnostics and recording.

Give the name of the instrument you would use to determine:

7.1 The amount of electric power consumed (1)

7.2 Reasons why the alarm clock (operating on AC) is losing time and the electric grinder seems to be turning slower (1)

7.3 House earthing continuity within acceptable limits (stipulated in the Code of Practice) (1)

7.4 If the supply at a point falls within the permissible 5% drop (1)

7.5 Whether the month's billing from the supplier would be high because of excessive power usage over long periods (1)

7.6 If the current rating of the supply cable is being exceeded (1)
[6]

QUESTION 8: TRANSFORMERS

A three-phase transformer has a star-connected primary and a delta-connected secondary. The transformer is connected to a 2,2 kV supply. The secondary-phase voltage is found to be 220 V.

Calculate the following:

8.1 Primary-phase voltage (3)

8.2 Secondary-line voltage (1)

8.3 Secondary-line current when at full-load (4)

8.4 Transformer rating in kVA (4)
[12]

QUESTION 9: ELECTRONICS

9.1 Explain how a diode is tested when it is suspected to be faulty. (2)

9.2 Explain how a Zener diode can be used as a voltage regulator. (2)

9.3 Draw the circuit symbol for a PNP transistor. Correctly label all the terminals. (4)

9.4 State TWO uses of a transistor. (2)
[10]

TOTAL: 100

FORMULA SHEET

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

$$I_{ACTIVE} = I_T \cos\phi$$

$$I_{REACTIVE} = I_T \sin\phi$$

$$X_L = 2\pi f L$$

$$X_C = \frac{1}{2\pi f C}$$

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

$$\phi = \cos^{-1}\left(\frac{R}{Z}\right)$$

$$V_R = I_T R$$

$$V_{XL} = I_T X_L$$

$$V_{XC} = I_T X_C$$

$$V = \sqrt{V_R^2 + (V_{XL} - V_{XC})^2}$$

$$P = I^2 R$$

$$P = \sqrt{3}\, V_L I_L \cos\phi$$

$$S = VI$$

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

DELTA

$$V_L = V_{PH/F}$$

$$I_L = \sqrt{3} I_{PH/F}$$

STAR

$$V_L = \sqrt{3} V_{PH/F}$$

$$I_L = I_{PH/F}$$

CABLES

$$I_{fc} = \frac{CIF \times A_r}{\sqrt{t}} \;/\; I_{fs} = \frac{CIF \times A}{\sqrt{t}}$$

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

$$\omega = 2\pi f$$

$$N = \frac{f.60}{p}$$

$$s = \frac{\quad}{n}$$

$$I = \frac{V - E}{R_a}$$

Serie motor

$$I_L = I_{se} = I_a$$

Long shunt

$$I_{se} = I_a$$

$$I_L = I_a = I_{sh/sj}$$

Short shunt

$$I_L = I_{se}$$

$$I_L = I_a = I_{sh/sj}$$

Series Resistors

$$R_T = R_1 + R_2 + \ldots R_n$$

Parallel Resistors

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