education

Department:
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NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N2

(11041872)

25 March (X-Paper)
09:00 – 12:00

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

DEPARTMENT OF EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
ELECTRICAL TRADE THEORY N2
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Number the answers correctly according to the numbering system used in this question paper.
3. Where applicable, answers must *be* in accordance with the SABS (SANS) Code of Practice SANS 10142-1:2003 for the Wiring of Premises.
4. Sketches must be neat, labelled and large enough to show the required detail.
5. Formulae used in Electrical Trade Theory N2 can be found at the end of this question paper.
6. Answers must be given to TWO decimal places.
7. Write neatly and legibly.

QUESTION 1: CONDUCTORS AND CABLES

1.1 The apparent power of a three-phase transformer is 100 kVA. Calculate the line current drawn by the transformer when the supply is 11 kV. (3)

1.2 State THREE disadvantages of installing high voltage cables in ducts. (3)

1.3 Flexible cables are usually joined by using splicing kits. State any THREE important considerations to keep in mind whilst making the joint. (3)

1.4 Give TWO reasons why an installation with a low power factor is costly to the consumer. (2)
[11]

QUESTION 2: SWITCHGEAR, CONTACTORS AND RELAYS

2.1 Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number (2.1.1 – 2.1.6) in the ANSWER BOOK.

2.1.1 A disconnector differs from a switch-disconnector because the disconnector cannot carry the on-load current. (1)

2.1.2 Switch-disconnectors are designed to open a highly inductive load at full voltage. (1)

2.1.3 A switch-disconnector must be connected to the neutral point of the supply. (1)

2.1.4 Overload current is defined as the current that flows when a short circuit occurs. (1)

2.1.5 An abnormally low ambient temperature will delay the tripping of thermal magnetic circuit breakers on overload. (1)

2.1.6 A circuit breaker may be used as a disconnector provided it complies with the standards of the relevant disconnectors. (1)

2.2 2.2.1 Explain the operation of relays. (3)

2.2.2 What is the difference between *relays* and *contactors*? (2)

2.2.3 What part of the relay is connected to the relay-control circuitry? (1)
[12]

QUESTION 3: D.C MOTORS AND STARTERS

3.1 Name the components pointed to in the D.C armature shown in FIGURE 1. Do NOT redraw the sketch. Write only the answer next to the question number (3.1.1 – 3.1.5) in the ANSWER BOOK.

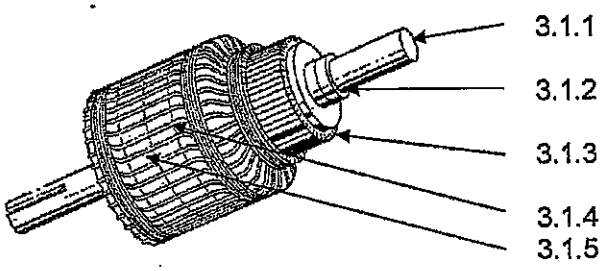

FIGURE 1 (5)

3.2 Explain how the field coil in a series motor is internally connected. (1)

3.3 Name TWO components that need regular replacement in D.C motors. (2)

3.4 Explain what happens to the speed of a series motor as the load decreases. (2)

3.5 Name TWO methods for changing the direction of rotation of D.C motors. (2)
[12]

QUESTION 4: A.C MOTORS AND STARTERS

4.1 4.1.1 Show with the aid of a sketch, how the stator windings of a three-phase induction motor are distributed around the stator. (2)

4.1.2 Use the same sketch to show how the coils are connected in star and to which wires the supply must be connected. (4)

4.2 4.2.1 Explain how a wound rotor induction motor can be started with a reduced starting current. (2)

4.2.2 Draw a neat, labelled circuit diagram to illustrate this method of starting. (3)

4.2.3 What interlocking must be used to protect this motor against over-current when starting? (2)

4.3 A multi-meter that normally indicates 1 Ω between two of the phase wires in the stator terminal box now measures 0,5 Ω. Explain whether you think there is a problem and what the cause could be. (2)
[15]

QUESTION 5: EARTHING

5.1 State the code of practice specifications about the earth continuity conductor if it:

5.1.1 Does not form part of the cable (2)

5.1.2 Carries prospective fault currents (2)

5.1.3 Does not have the necessary conductivity (2)

5.2 What is the main function of each of the following:

5.2.1 A cable gland (2)

5.2.2 An earth-tag washer (2)

5.3 Explain how overhead shielding for earthing is provided for at power stations. (2)
[12]

QUESTION 6: PROTECTION

6.1 Discuss valve lightning arrestors under the following headings:

6.1.1 Construction (2)

6.1.2 The properties of the ceramic compound of the valve core (2)

6.1.3 Operation during normal circuit voltage (1)

6.1.4 Operation during over-voltage (1)

6.2 Briefly explain the function of each of the following:

6.2.1 Fuses (2)
6.2.2 No volt coils (2)
[10]

QUESTION 7: MEASURING INSTRUMENTS

7.1 Explain the function of the kilowatt-hour meter. (2)

7.2 Draw a neat, fully labelled circuit diagram showing how to couple a wattmeter into a single-phase circuit. (3)

7.3 Define *maximum demand.* (1)
[6]

QUESTION 8: TRANSFORMERS

8.1 A 100 kVA single-phase ideal transformer's secondary voltage is 220 V when the supply to the transformer is 11 kV. Calculate the following:

8.1.1 Turns ratio (3)

8.1.2 Value of the primary current at full load (3)

8.1.3 Maximum secondary current (3)

8.2 The primary winding of a three-phase transformer is star connected. If the primary line current is 57,74 A and the supply is 380 V, calculate the following:

8.2.1 The primary line voltage (1)

8.2.2 The primary phase current (1)

8.2.3 The voltage across each phase in the primary (1)
[12]

QUESTION 9: ELECTRONICS

9.1 Complete the sentences by selecting the most appropriate terms from the list below. Write only the term next to the question number (9.1.1 – 9.1.5) in the ANSWER BOOK.

continuous current; reverse voltage; active; power; avalanche breakdown voltage; cut off; transistor; trigger plus; diode

9.1.1 The ... region of a transistor is when the collector current is proportional to the base current.

9.1.2 The value of the reverse bias voltage that causes the zener diode to conduct is called the ... .

9.1.3 The ... rating is the maximum power that the device is capable of consuming.

9.1.4 The ... rating is the maximum steady state current that a diode can conduct without exceeding the allowable temperature.

9.1.5 The ... rating is the maximum voltage that can be across the diode when reverse biased (without damaging the diode). (5)

9.2 Study the thyristor circuit in FIGURE 2 and then answer the questions that follow:

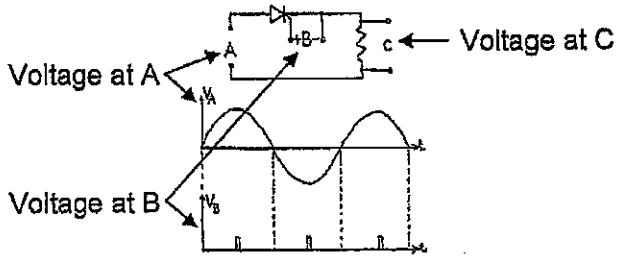

FIGURE 2

9.2.1 Draw a waveform that will appear at C during the same time interval. (3)

9.2.2 Explain why you expect this waveform at C. (2)
[10]

TOTAL: 100

ELECTRICAL TRADE THEORY N2

FORMULA SHEET

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

$$I_{ACTIVE/AKTIEWE} = I_T Cos\theta$$

$$I_{REACTIVE/REAKTIEWE} = I_T Sin\theta$$

$$X_L = 2\pi fL$$

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

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

$$\theta = Cos^{-1}\left[\frac{R}{Z}\right]$$

$$V_R = I_T R$$

$$V_{X_L} = I_T X_L$$

$$V_{X_C} = I_T X_C$$

$$V = \sqrt{V_R^{\ 2} + (V_{X_L} - V_{X_C})^2}$$

$$P = I^2 R$$

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

$$S = VI$$

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

DELTA

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

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

STAR / STER

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

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

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

$$\omega = 2\pi f$$

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

$$s = \frac{n - n_r}{n}$$

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

Series motor/Seriemotor

$I_L = I_{se} = I_a$

Long shunt/Langsjunt

$I_{se} = I_a$

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

Short shunt/Kortsjunt

$I_L = I_{se}$

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

Series Resisto /Serie weerstande

$$R_T = R_1 + R_2 + ...R_n$$

Parallel Resistors/Paralelle weerstande

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