higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL SYSTEMS AND CONSTRUCTION
NQF LEVEL 4

(12041034)

12 March 2018 (Y-Paper)
13:00–16:00

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

NCV

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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. Write neatly and legibly.

NCV

QUESTION 1

1.1 Condensers use different cooling systems.

Name TWO types of cooling systems that are used at Eskom's power plants. (2)

1.2 In a power station, a generator is being driven by a steam turbine.

Give a brief description of the function of a generator. (2)

1.3 Explain why substations have a back-up supply. (2)

1.4 Ring feed networks are usually preferred for urban areas.

1.4.1 Give a brief description of ring feed networks.

1.4.2 What could be the effect of faulty transmission lines on ring feed networks?

(2 × 2) (4)

1.5 Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A-F) next to the question number (1.5.1-1.5.5) in the ANSWER BOOK.

	COLUMN A		COLUMN B
1.5.1	They protect conductors and other components from short circuits or damage caused by trees and flying debris during storms.	A	surge arrestors
1.5.2	They open a circuit when there is an interruption and close it again after an interruption, in order to resume power transfer.	B	dead-end clamps
1.5.3	They are used to isolate parts of a line that have malfunctioned and was shut down at the substation.	C	twig protectors
1.5.4	They protect against sudden increase in power.	D	knife switches
1.5.5	They hold the ends of conductors.	E	reclosers
		F	bushings

(5 × 2) (10)

[20]

QUESTION 2

2.1 Different motor starting methods are used to prevent damage to motor windings due to a high starting current.

Name THREE protective devices installed in motor starter circuits. (3)

2.2 Give TWO examples of resistive loads which convert electrical energy into light or heat. (2)

2.3 Load testing is one of the tests that are done after the design and construction of a 3-phase circuit.

State TWO purposes for load testing. (2)

2.4 You have just constructed a direct-on-line motor starter circuit.

Name the TWO circuits that you have used in the design of this circuit. (2)

2.5 Explain the function of the following components:

2.5.1 An earth-leakage relay

2.5.2 An uninterruptible power supply

2.5.3 A proximity switch

(3 × 2) (6)

[15]

QUESTION 3

3.1 Every municipality has got its own by-laws which must be adhered to, by all people involved with electricity.

State the purpose for municipality by-laws. (2)

3.2 Briefly explain the term *servitude.* (2)

3.3 You were granted the tender to erect a three-phase medium-voltage overhead supply to domestic houses.

State FIVE activities that are involved in successfully completing this task. (5)

3.4 To mark out the route when erecting overhead distribution lines, you have to physically visit the site.

State FOUR factors that you will consider when designing and marking the route for overhead distribution lines. (4)

3.5 State ONE purpose for the Occupational Health and Safety Act. (2)

[15]

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QUESTION 4

4.1 Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number (4.1.1-4.1.10) in the ANSWER BOOK.

4.1.1 When testing conductors for continuity, you must remove them from the circuit.

4.1.2 Electrical bonding is between the earth terminal and all exposed conductive parts of an installation.

4.1.3 Once the earth continuity test is done, you do not need to measure the resistance of the earth continuity conductor.

4.1.4 The insulation resistance testing of conductors is done only on live conductors.

4.1.5 The value of the elevated voltage between the incoming neutral and earth on the installation should at least be 20 V.

4.1.6 A circuit should carry a fault current of twice the rated circuit current.

4.1.7 The value of the insulation resistance between conductors of an installation should be 0,5 MΩ.

4.1.8 The voltage drop from the point of supply to the furthest point of consumption should not be more than 5% of the declared phase-to-neutral voltage.

4.1.9 When conducting the voltage-on-available-load test, the maximum available load must be connected.

4.1.10 When conducting the insulation resistance test on an installation, all loads must be disconnected.

(10 × 1) (10)

4.2 Before you can conduct inspections and tests on a building, you have to perform a risk assessment.

Explain the importance of performing risk assessment at the workplace. (2)

4.3 Name TWO of the regulations that must be obeyed when conducting tests on a three-phase installation. (2)

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4.4 State the function of the following electrical testing instruments:

4.4.1 Earth-loop tester

4.4.2 Phase rotation meter

4.4.3 Earth electrode resistance tester

(3 × 2) (6)
[20]

QUESTION 5

5.1 A power transformer is overheating and therefore has to be isolated and decoupled from the energy source.

Explain the procedure for isolating a three-phase transformer. (4)

5.2 Name TWO faults that could occur on a cable. (2)

5.3 State THREE factors that could cause an electric motor to overheat. (3)

5.4 A motor control gear is found to be faulty and you have to gather information about both the control gear and the problem.

State any THREE of the procedures you will follow in order to gather information on both the motor control gear and the problem. (6)
[15]

QUESTION 6

6.1 A college needs to reduce its monthly consumption of electricity by switching some of its load to a solar system. Below is the load that has to be connected to a solar system:

- Air condition, 6 400 W - used for 7 hours per day
- Lights, 64 W - used for 8 hour per day
- Microwave 900 W - used for 2 hours per day

Cost per 1 kWh = R1,50 and the number of days in use is = 20 days

Calculate:

6.1.1 Power consumption (in kWh/day) for each appliance (6)

6.1.2 Total power consumption (in kWh/day) (2)

6.1.3 An amount that will be saved in rand (2)

6.2 Give THREE factors that determine the battery capacity. (3)

6.3 Explain the effect of summer and winter on solar arrays. (2)
[15]

TOTAL: 100

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FORMULA SHEET

ELECTRICAL SYSTEMS AND CONSTRUCTION L4

1. $E_{\min} = \dfrac{E_{daily} \times days}{BDD}$

2. $Ah = \dfrac{E_{\min}}{Battery \cdot voltage}$

3. $Ah = \dfrac{E_{\min} \times k \times k_c \times k_a}{Battery \cdot voltage}$

4. $Voltage \cdot drop = Vcons\tan t \times l \times I$

5. $Voltage \cdot drop\% = \dfrac{V_{DROP}}{V_{SUPPLY}} \times 100\%$

6. $P_A = \dfrac{Wattage \times time}{1000}(kWh)$

7. $P_T = P_{A1} + P_{A2} + P_{AN}\,(kWh)$

8. $C_T = P_T \times Days/mnth \times E\cos t/kWh$

9. $P_W = \dfrac{1}{2}\rho A v^3$

10. $P_T = \dfrac{1}{2}\rho A v^3 \cdot C_T$

11. $P = V \times I$

12. $P_a = V_{rms} \times I_{rms}$

13. $P_a = P_f \times P$

14. $P_T = P_a \times units$

15. $P_{INPUT} = \dfrac{P_{OUT}}{\eta}$

16. $P_a = \dfrac{P_{INPUT}}{\eta}$

17. $R = \dfrac{R_W \times I}{1000}$

18. $V_{DROP} = \dfrac{R_W \times l \times I}{1000}$

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