



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE ELECTRO-TECHNOLOGY N3

(11040343)

**15 August 2025 (X-paper)
09:00–12:00**

Drawing instruments and non-programmable calculators may be used.

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

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
ELECTRO-TECHNOLOGY N3
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. Keep subsections of questions together.
 5. Round all calculations off to THREE decimal places.
 6. Use the correct symbols and units.
 7. Use only a black or blue pen.
 8. Write neatly and legibly.
-

QUESTION 1

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1–1.10) in the ANSWER BOOK.

- 1.1 Armature core consists of steel laminated plates which are insulated from each other with varnish.
- 1.2 The purpose of a commutator in a direct current motor is to ensure that a steady direct voltage is obtained from the alternating EMF generated in the rotating conductors.
- 1.3 Efficiency of an electrical machine can be defined as the ratio of the input power to the output power.
- 1.4 A motor converts mechanical energy into electrical energy.
- 1.5 In a direct current machine, bearings are used to minimize friction.
- 1.6 In an alternating current circuit, the component at 90° to the voltage is called an active component of the current.
- 1.7 Delta connection is one of the methods used to connect a 3-phase load.
- 1.8 Three-phase network has two operating voltages known as the phase voltage and line voltage.
- 1.9 The transformer consists of primary and secondary windings which are electrically connected to each other.
- 1.10 The function of logic gate is to complete or interrupt the circuits.

(10 × 1)

[10]

QUESTION 2

- 2.1 Explain the purpose of the pole shoes in DC machines. (2)
- 2.2 A four pole DC motor has a wave wound armature with 8 conductors per slot. The motor develops a torque of 95 Nm when 40 A flow through its armature. For a useful flux per pole of 30 mWb, calculate the total number of armature slots. (4)
- 2.3 Compound generators are used to produce a nearly constant output voltage.
- ✦ Draw a neat, labelled circuit diagram of a cumulative compound-wound generator and clearly show the following: (4)
- All currents and their direction.
 - The output power.

QUESTION 3



- 3.1 State THREE methods used to improve commutation. (3)
- 3.2 Define what is meant by the following factors:
- 3.2.1 Pole pitch (2)
- 3.2.2 Coil pitch (2)
- 3.3 A six-pole lap wound direct current generator rotates at 1200 r/min. The useful flux per pole is 20 mWb and the value of the generated EMF is 240 V. Calculate the total number of armature conductors. (3)
- [10]**

QUESTION 4

- 4.1 Efficiency of DC machines can be determined using different methods. Give another name for:
- 4.1.1 Indirect method (1)
- 4.1.2 Hopkinson method (1)
- 4.2 The following data was recorded using the rope brake test method on a DC motor:
- | | |
|--------------------------------|-------------------------|
| Effective load on the pulley | = 19,5 kg |
| Supply voltage | = 210 V |
| Supply current | = 35 A |
| Effective radius on the pulley | = 0,3 m |
| Efficiency of the motor | = 91 % |
| Acceleration due to gravity | = 9,81 m/s ² |
- 4.2.1 The input power of the motor. (2)
- 4.2.2 The output power of the motor. (2)
- 4.2.3 The effective load in Newtons. (1)
- 4.2.4 The speed of the motor. (3)
- [10]**



QUESTION 5

5.1 An alternating EMF is represented by $e = 250 \sin(640t)$ V .

Determine the following:

5.1.1 The frequency of the EMF. (2)

5.1.2 The instantaneous value of the EMF 0.003 seconds after zero. (2)

5.2 The following mid-ordinates have been taken during half cycle of an alternating current wave:

$$i_1 = 1,3 \text{ A}$$

$$i_2 = 3,8 \text{ A}$$

$$i_3 = 6 \text{ A}$$

$$i_4 = 7,9 \text{ A}$$

$$i_5 = 9 \text{ A}$$

$$i_6 = 10,2 \text{ A}$$

$$i_7 = 9 \text{ A}$$

$$i_8 = 8,6 \text{ A}$$

Calculate the following:

5.2.1 The average value of the waveform. (3)

5.2.2 The RMS value of the waveform. (3)

[10]

QUESTION 6

6.1 A resistor of 12Ω is connected in parallel with a 38 mH inductor and all is connected to a 200 V, 50 Hz supply. Calculate the following:

6.1.1 The current through the resistor. (1)

6.1.2 The current through the inductor. (3)

6.1.3 The total current flowing in the circuit. (2)

6.2 A parallel circuit is tuned to a frequency of 1 kHz with an inductor of 150 mH.

Calculate the capacitance of the capacitor in the circuit if the frequency is at resonance.

(4)

[10]

QUESTION 7

7.1 State FOUR advantages of a three-phase system over a single-phase system. (4)

7.2 A 150 kW, three-phase alternating current motor is connected in delta and the supply voltage is 650 V.

Calculate the following if the power factor is 0,88:

7.2.1 The phase voltage of the motor. (1)

7.2.2 The phase current of the motor. (5)

[10]

QUESTION 8

8.1 Name TWO methods used to cool a transformer. (2)

8.2 A single-phase transformer has 1200 primary turns and 300 secondary turns.

For a supply voltage of 230 V, calculate the following:

8.2.1 The turns ratio of the transformer. (2)

8.2.2 The secondary voltage. (2)

8.2.3 The secondary current if the primary current is 5 A. (2)

8.2.4 The rating of the transformer. (2)

[10]

QUESTION 9

9.1 Name TWO types of moving-iron instruments. (2)

9.2 Name TWO types of damping devices. (2)

9.3 A moving-coil instrument with an internal resistance of 200 Ω , gives full scale deflection when 20 mA flows through it.

Calculate the values of the following:

9.3.1 Series resistor that the meter can be used as a voltmeter to measure a voltage up to 100 V. (3)

9.3.2 Shunt resistor to be used with the meter so that it will be able to measure a current of up to 10 A. (3)

QUESTION 10

10.1 Name FIVE logic gates that are used as basic components in electronic circuits. (5)

10.2 Add the following binary numbers using the rules for binary addition:

$$1011_2 + 1111_2$$

(5)

[10]



TOTAL:

100

IO-TECHNOLOGY N3

FORMULA SHEET

Any applicable formula may also be used.

1. $E = V - I_a R_a$
2. $E = V + I_a R_a$
3. $E = 2p\Phi \frac{ZN}{60c}$
4. $N = \frac{V}{K\Phi}$
5. $T = \frac{0,318 I_a Zp \Phi}{C}$
6. $Efficiency = \frac{VI}{VI + I_a^2 R_a + I_s V + C} \times 100 \%$
7. $Efficiency = \frac{VI - (I_a^2 R_a + I_a V + C) \times 100 \%}{VI}$
8. $Efficiency = \frac{2\pi N(W - S)r}{60 VI} \times 100 \%$
9. $Efficiency = \sqrt{\frac{I_1}{I_1 + I_2}} \times 100 \%$
10. $E = Blv$
11. $e = E_m \sin 2\pi ft$
12. $i = I_m \sin 2\pi ft$
13. $e_{ave} = 0,367 E_m$ or $i_{ave} = 0,637 I_m$
14. $e_{rm} = 0,707 E_m$ or $i_{rms} = 0,707 I_m$
15. $E_{ave} = \frac{e_1 + e_2 + e_3 + \dots + e_n}{n}$
or $I_{ave} = \frac{i_1 + i_2 + i_3 + \dots + i_n}{n}$
16. $E_{rms} = \sqrt{\frac{e_1^2 + e_2^2 + e_3^2 + \dots + e_n^2}{n}}$
or $I_{rms} = \sqrt{\frac{i_1^2 + i_2^2 + i_3^2 + \dots + i_n^2}{n}}$
17. $Form\ factor = \frac{E_{rms}}{E_{ave}} \text{ or } \frac{I_{rms}}{I_{ave}}$
18. $Crest\ factor = \frac{E_m}{E_{rms}} \text{ or } \frac{I_m}{I_{rms}}$
19. $I = \frac{V}{R}$
20. $X_L = 2\pi fL$; $I = \frac{V}{X_L}$

21. $X_C = 2\pi fC$; $I = \frac{V}{X_C}$
22. $Z = \sqrt{R^2 + X_L^2}$; $Z = \sqrt{R^2 + X_C^2}$; $I = \frac{V}{Z}$
23. $\tan \theta = \frac{X_L}{R}$; $\tan \theta = \frac{X_C}{R}$
24. $V_R = I \times R$; $V_L = I \times X_L$; $V_C = I \times X_C$
25. $Z = \sqrt{R^2 + (X_L - X_C)^2}$; $Z = \sqrt{R^2 + (X_C - X_L)^2}$
26. $\tan \theta = \frac{X_L - X_C}{R}$; $\tan \theta = \frac{X_C - X_L}{R}$
27. $P = V \times I$; $P = I^2 R$; $P = \frac{V^2}{R}$
28. $P = VI \cos \theta$
29. $\cos \theta = \frac{R}{Z}$ or $\cos \theta = \frac{W \text{ or } kW}{VA \text{ or } kVA}$
30. $I_{active} = I \cos \theta$; $I_{reactive} = I \sin \theta$
31. $Q = VI \sin \theta$
32. $f_r = \frac{1}{2\pi\sqrt{LC}}$
33. $I = \sqrt{I_R^2 + I_L^2}$; $\tan \theta = \frac{I_L}{I_R}$
34. $I = \sqrt{I_R^2 + I_C^2}$; $\tan \theta = \frac{I_C}{I_R}$
35. $I = \sqrt{I_R^2 + (I_L - I_C)^2}$; $\tan \theta = \frac{I_L - I_C}{I_R}$
36. $I = \sqrt{I_R^2 + (I_C - I_L)^2}$; $\tan \theta = \frac{I_C - I_L}{I_R}$
37. $\cos \theta = \frac{I_R}{I}$
38. $V_L = V_P$; $I_L = \sqrt{3} I_P$
39. $V_L = \sqrt{3} V_P$; $I_L = I_P$
40. $W = \sqrt{3} V_L I_L \cos \theta \times \eta$
41. $\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$
42. $kVA = \frac{\sqrt{3} V_L I_L}{1000}$
43. $V_{shunt} = V_{meter}$; $I_s R_s = I_m R_m$
44. $I_T = I_m + I_s$
45. $I_T = \frac{V_T}{R_T}$