education

Department:
Education
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

ELECTRO-TECHNOLOGY N3

(11040343)

7 April (X-Paper)
09:00 – 12:00

This question paper consists of 6 pages and a 3-page formula sheet.

DEPARTMENT OF EDUCATION
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 correctly according to the numbering system used in this question paper.
4. Full marks can be obtained by answering questions to the value of 100 marks correctly.
5. The correct information must be copied from the question paper and to be substituted for the correct symbol.
6. ALL sketches/diagrams must be done in pencil and be neat, reasonably large and fully labelled.
7. The answers must be worked to THREE decimal places after a comma, for example 3,142.
8. Use the correct units for answers.
9. Write neatly and legibly.

QUESTION 1

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) in the ANSWER BOOK.

1.1 It is used to reduce the effects of eddy currents. (2)

1.2 It is the main frame and made of a magnetic material. (2)

1.3 It is around each pole piece for excitation to supply the field flux. (2)

1.4 It is used for current to enter and leave the armature. (2)

1.5 It is used when the ampere turns of the two windings oppose each other. (2)
[10]

QUESTION 2

2.1 State TWO disadvantages of commutation process. (2)

2.2 Briefly explain what a short compound motor is. (2)

2.3 State the function of a commutation in the connection below:

2.3.1 A motor (1)

2.3.2 A generator (1)

2.4 An eight pole machine has a wave wound armature with conductors per slot. The flux per pole is 20 mWb and the EMF generated at 820 r/min is 109,33 Volts.

Determine the total number of conductors in the armature. (4)
[10]

QUESTION 3

3.1 Give TWO important reasons for decrease in terminal voltage of a separately excited generator. (2)

3.2 State ONE purpose of the separately excited generator. (1)

3.3 State ONE use of the following components in direct current machine:

3.3.1 Shunt generator (1)

3.3.2 Series generator (1)

3.4 Name TWO variable factors that the torque of a direct current motor depend upon. (2)

3.5 State THREE applications of the series motors. (3)
[10]

QUESTION 4

4.1 State TWO advantages of direct current motor over alternating current motor. (2)

4.2 Use THREE diagrams to show different methods which could be used to reverse the direction of rotation in direct current motor. (6)

4.3 Briefly explain how time delay is obtained in the piston of a face plate resistance starter. (2)
[10]

QUESTION 5

An output voltage of 220 volts at a current of 140 amperes is delivered by a shunt generator. The armature and field resistance are 0,075 ohms and 60 ohms respectively. The no-load current is 2,545 amperes.

Determine the following:

5.1 Shunt current (2)

5.2 Armature current (2)

5.3 Efficiency of generator (6)
[10]

QUESTION 6

An alternating quantity is represented by equation: $e = 80 \sin 314{,}428\ t$ volts.

Determine the following:

6.1 Specify type of alternating quantity (1)

6.2 Maximum value of the alternating quantity (1)

6.3 The frequency of the alternating quantity (3)

6.4 The period time in (mS) of the alternating quantity (2)

6.5 The instantaneous value of the alternating quantity 10 milliseconds after zero increasing positively (3)
[10]

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QUESTION 7

A parallel circuit comprises a capacitor of 12,5 micro-farads, a resistance of 45 ohms and a pure inductor of 200 milli-henry all connected across a 220 V/ 50 Hz supply.

Determine the following:

7.1 The current through each component (5)

7.2 The total current flows in the circuit (3)

7.3 The power consumed in the circuit (2)
[10]

QUESTION 8

8.1 State TWO functions of Oil Immersed type in a transformer. (2)

8.2 A three-phase transformer has a primary star connection and secondary delta connection. The input line voltage is 380 volts and output line voltage is 6 600 volts.

Determine the following:

8.2.1 The primary phase voltage (2)

8.2.2 The transformer-ratio (3)

8.2.3 The secondary line current when the primary line current is 900 A (3)
[10]

QUESTION 9

9.1 Explain, by means of a neat, labelled sketch, a dynamo-meter instrument. (7)

9.2 Name THREE basic control mechanisms which are found in electrical analogue measuring instruments. (3)
[10]

QUESTION 10

10.1 State ONE function of the following components:

10.1.1 Transistor (1)

10.1.2 Diode (1)

10.1.3 Silicon control rectifier (SCR) (1)

10.2 Explain the term *positive voltage level* and support the answer with a suitable sketch. (3)

10.3 Explain the NAND gate by means of a neat, labelled mechanical sketch. (4)
[10]

TOTAL: 100

ELECTRO-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. $E = 2p\Phi \dfrac{ZN}{60C}$

4. $N = \dfrac{V}{K\Phi}$

5. $T = \dfrac{0{,}318\ I_a\ Zp\ \Phi}{C}$

6. $\textit{Efficiency/Rendement} = \dfrac{VI}{VI + Ia^2Ra + IsV + C} \times 100$

7. $\textit{Efficiency/Rendement} = \dfrac{VI - (Ia^2Ra + IsV + C) \times 100}{VI}$

8. $\textit{Efficiency/Rendement} = \dfrac{2\pi N\,(W - S) \times r}{60\ VI} \times 100$

9. $\textit{Efficiency/Rendement} = \sqrt{\dfrac{I_1}{I_1 + I_2}} \times 100$

10. $E = Blv$

11. $e = E_m Sin2\pi ft$

12. $i = I_m Sin2\pi ft$

13. $e_{ave/gem}$ *of/or* $i_{ave/gem} = 0{,}637\ Em$ *or/of* Im

14. $e_{rms/wgk}$ *or/fr* $i_{rms/wgk} = 0{,}707\ Em$ *or/of* Im

15. $E_{ave/gem} = \dfrac{e_1 + e_2 + e_3 + \ldots + e_n}{n}$

    or/of $I_{ave/gem} = \dfrac{i_1 + i_2 + i_3 + \ldots + i_n}{n}$

16. $E_{rms/wgk} = \sqrt{\frac{e_1^2 + e_2^2 + e_3^2 + ... + e_n^2}{n}}$

or/of $I_{rms/wgk} = \sqrt{\frac{i_1^2 + i_2^2 + i_3^2 + ... + i_n^2}{n}}$

17. $Form\ factor/Vormfaktor = \frac{E_{rms/wgk}}{E_{ave/gem}}\ or/of\ \frac{I_{rms/wgk}}{I_{ave/gem}}$

18. $Crest\ factor/Kruinfaktor = \frac{E_m}{E_{rms/wgk}}\ or/of\ \frac{I_m}{I_{rms/wgk}}$

19. $I = \frac{V}{R}$

20. $X_L = 2\pi fL\ ;\ i = \frac{V}{X_L}$

21. $X_C = \frac{1}{2\pi fC}\ ;\ i = \frac{V}{X_C}$

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. $VR = I \times R\ ;\ V_L = I \times X_L\ ;\ V_C = I \times X_C$

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

26. $\text{Tan}\ \theta = \frac{X_L - X_C}{R}\ ;\ Tan\ \theta = \frac{X_C - X_L}{R}$

27. $P = V \times I\ ;\ P = I^2R\ ;\ P = \frac{V^2}{R}$

28. $P = VI \text{Cos}\ \theta$

29. $\text{Cos}\ \theta = \frac{R}{Z}\ ;\ Cos\ \theta = \frac{W\ or/of\ KW}{VA\ or/of\ KVA}$

30. $I_{active/aktief} = I\ cos\ \theta$
$I_{reactive/reaktief} = I \sin \theta$

PTO

31. $P = VI \cos \theta$

$Q = VI \sin \theta$

32. $fr = \frac{1}{2\pi\sqrt{LC}}$

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. $V_L = V_P$; $I_L = \sqrt{3}\,Ip$

39. $V_L = \sqrt{3}\,Vp$; $I_L = I_p$

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. $KVA = \frac{\sqrt{3}\,V_L I_L}{1\,000}$

43. $V_{shunt/sjunt} = V_{meter}$; $I_s R_s = I_m R_m$

44. $I_T = I_m + I_s$

45. $I_T = \frac{V_T}{R_T}$