higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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APRIL EXAMINATION

NATIONAL CERTIFICATE

ELECTRO-TECHNOLOGY N3

(11040343)

5 April 2016 (X-Paper)
09:00–12:00

This question paper consists of 7 pages and 1 formula sheet of 3 pages.

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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 The correct information must be copied from the question paper and substituted for the correct symbol.
5. Keep the subsections of questions together.
6. Rule off after the completion of EACH question.
7. Sketches and diagrams must be done in pencil.
8. The sketches/diagrams must be neat, reasonably large and fully labelled.
9. The answers must be worked to THREE decimal places.
10. Use the correct units for answers.
11. Write neatly and legibly.

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QUESTION 1

1.1 Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (1.1.1–1.1.2) in the ANSWER BOOK.

1.1.1 The (field winding, yoke, pole shoes) is that part of the DC machine which protects the inner parts. (2)

1.1.2 (Field poles, pole shoes, carbon brushes) are used to increase the efficiency of the magnetic path. (2)

1.2 Briefly explain the following methods to minimise the effects of armature reaction.

1.2.1 Brush shifting (2)

1.2.2 Interpoles (2)

1.2.3 Increasing the field flux (2)
[10]

QUESTION 2

2.1 State FOUR factors which the magnitude of an induced EMF in a conductor depends on. (4)

2.2 Name TWO generators which are dependent on the excitation process in order to operate, and support your answer with two relevant sketches. (6)
[10]

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QUESTION 3

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

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

3.3 Briefly state ONE application for each of the following types of generator.

3.3.1 Shunt generator (1)

3.3.2 Series generator (1)

3.4 Name TWO variable factors that the torque of a DC motor depends on. (2)

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

QUESTION 4

A brake test was performed on a DC motor and the following information obtained:

The drum radius	=	300 mm
Drum speed	=	420 rev/min
Effective load	=	425 N.m
The supply voltage	=	0,21 kV
The current absorbed by the motor	=	33 000 mA

Determine the following:

4.1 Input power of the motor in kW (3)

4.2 Output power of the motor in kW (4)

4.3 The motor efficiency (3)
[10]

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QUESTION 5

5.1 The following ordinate points were read from the full cycle of an alternating quantity.

e_1 = 20 V; e_2 = 42 V; e_3 = 83 V; e_4 = 120 V; e_5 = 95 V; e_6 = 35 V; e_7 = 18 V.

Determine the following from the above data:

5.1.1 What type of alternating quantity is mentioned above? (1)

5.1.2 Actual value (3)

5.1.3 Average value (3)

5.1.4 Form factor (1)

5.1.5 What type of wave form is deduced from the value of the crest factor, if crest factor is 1,414 and form factor as calculated in QUESTION 5.1.4? (1)

5.2 Define *maximum value.* (1)
[10]

QUESTION 6

An RLC circuit consists of a 400 mH inductor, a resistor of 10 Ω and a 50 mF capacitor. The circuit is connected in series across a 240 V/60 Hz supply.

Determine the following:

6.1 The impedance of the circuit (5)

6.2 The circuit current (2)

6.3 The phase angle and state whether it is leading or lagging (3)
[10]

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QUESTION 7

7.1 State TWO advantages of a star connection. (2)

7.2 A 380 V, three-phase, star-connected motor is rated at 25 kW. The full load power factor is given as 0,8 and the efficiency as 85%.

Determine the following:

7.2.1 The line voltage for the motor when it runs at full load. (1)

7.2.2 The phase voltage for the motor when it runs at full load. (2)

7.2.3 The phase current for the motor when it runs at full load. (5)
[10]

QUESTION 8

8.1 What is the colour of silica gel after it absorbs moisture? (1)

8.2 Name TWO sources of losses that occur in a transformer. (2)

8.3 A single-phase transformer has 42 turns on the secondary winding and is connected to a 210V AC supply. The output voltage is 70V and the primary current is 218 mA.

Determine the following:

8.3.1 Primary number of turns (2)

8.3.2 Secondary current in amperes (2)

8.3.3 Secondary VA if ALL losses are ignored. (1)
[8]

QUESTION 9

9.1 Draw a neat labelled sketch of a dynamometer as an electrical measuring instrument. (7)

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

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QUESTION 10

10.1 Draw and label the following gates by its IEC symbols.

10.1.1 AND gate (2)

10.1.2 NOR gate (2)

10.2 Change the following decimal numbers to binary and show ALL necessary steps.

10.2.1 $10,5_{10}$. (2)

10.2.2 $14,25_{10}$. (2)

10.2.3 Subtract the answer of QUESTION 10.2.1 from QUESTION 10.2.2 and leave the answer in binary number. (2)

10.3 Briefly explain with the aid of a neat sketch the concept of forward bias. (2)
[12]

TOTAL: 100

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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. $E = 2p\Phi \frac{ZN}{60c}$
4. $N = \frac{V}{K\Phi}$
5. $T = \frac{0,318 I_a Zp\Phi}{C}$
6. Efficiency/Rendement = $\frac{VI}{VI + I_a^2 R_a + I_s V + C} \times 100\%$
7. Efficiency/Rendement = $\frac{VI - (I_a^2 R_a + I_s V + C)}{VI} \times 100\%$
8. Efficiency/Rendement = $\frac{2\pi N(W - S)r}{60VI} \times 100\%$
9. Efficiency/Rendement = $\sqrt{\frac{I_1}{I_1 + I_2}} \times 100\%$
10. $E = Blv$
11. $e = E_m \text{Sin} 2\mu ft$
12. $i = I_m \text{Sin} 2\mu ft$
13. $e_{ave/gem}$ or/of $i_{ave/gem} = 0,637\ E_m$ or/of I_m
14. $e_{rms/wgk}$ or/of $i_{rms/wgk} = 0,707\ E_m$ or/of I_m
15. $E_{ave/gem} = \frac{e_1 + e_2 + e_3 + e_4 + ... + e_n}{n}$

    Or/of $I_{ave/gem} = \frac{i_1 + i_2 + i_3 + ... + i_n}{n}$

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

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

22. $Z = \sqrt{R^2 + X_L^2}$; $Z = \sqrt{R^2 + X_C^2}$; $I = \frac{V}{Z}$

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

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

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

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

29. $\text{Cos } \theta = \frac{R}{Z}$; $\text{Cos } \theta = \frac{Wor/ofkW}{VAor/ofkVA}$

30. $I_{active/aktief} = ICos\theta$; $I_{reactive/reaktief} = ISin\theta$

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

$Q = VI \text{ Sin } \theta$

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

33. $I = \sqrt{I_R{}^2 + I_L{}^2}$; Tan θ = $\frac{I_L}{I_R}$

34. $I = \sqrt{I_R{}^2 + I_C{}^2}$; Tan θ = $\frac{I_C}{I_R}$

35. $I = \sqrt{I_R{}^2 + (I_L - I_C)^2}$; Tan θ = $\frac{I_L - I_C}{I_R}$

36. $I = \sqrt{I_R{}^2 + (I_C - I_L)^2}$; Tan θ = $\frac{I_C - I_L}{I_R}$

37. Cos θ = $\frac{I_R}{I}$

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

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

44. $I_T = I_m + I_s$

45. $I_t = \frac{V_t}{R_t}$

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