higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

ELECTRO-TECHNOLOGY N3

(11040343)

25 November (X-Paper)
09:00 – 12:00

This question paper consists of 5 pages and a 3-page formula sheet.

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 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. Sketches and diagrams MUST be done in PENCIL. The sketches/diagrams MUST be neat, reasonably large and fully labelled.
7. The answer must be worked to THREE decimal places after the comma, for example 3,142.
8. Use the correct units for answers.
9. Write neatly and legibly.

QUESTION 1

1.1 Briefly explain and give ONE function (use) of the following as found in DC machines:

1.1.1 Lap wound (2)
1.1.2 Wave wound (2)

1.2 Name and explain THREE methods which are employed to counteract commutation. (6)
[10]

QUESTION 2

2.1 Briefly explain how a series motor is connected and support the answer with a suitable sketch. (3)

2.2 Write the expression or formula for an EMF generated in a DC machine having time [T] and flux per pole [Φ]. (2)

2.3 Briefly explain, by means of a drawing which shows the basic principles of operation of an electric motor. Include the relative directions of ALL components (flux, EMF, current, force and motion) in the drawing. (5)
[10]

QUESTION 3

3.1 State THREE variables which the back EMF is dependent upon. (3)

3.2 State THREE disadvantages when comparing a direct current motor and an alternating current motor. (3)

3.3 Briefly describe time delay in the bi-metal strip type. (4)
[10]

QUESTION 4

4.1 Determine the back EMF generated in the armature of a 500 V direct current motor with an armature circuit resistance of 0,4 ohms when it runs a load with an armature current of 100 amperes. (3)

4.2 Explain by means of a neat, labelled sketch a face plate starter for a shunt motor. (7)
[10]

PTO

QUESTION 5

A brake test is performed on a DC motor with an effective load of 450 Nm at a drum speed of 1 920 r/min. The effective radius of a drum is 45 centimeters and the input to the motor is 0,06 kilo-amperes at 460 volts.

Determine the following:

5.1	The input power	(2)
5.2	The output power in kW	(5)
5.3	The efficiency of the motor	(3)
		[10]

QUESTION 6

An RLC circuit consists of a 200 milli-henry inductor, a resistor of 0,015 kilo-ohms and a 100 micro-farads capacitor. The circuit is connected in series across a 250 V/50 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 is leading or lagging	(3)
		[10]

QUESTION 7

A 200 kW, three-phase alternating current motor is connected in delta and the supply voltage is 440 volts. The power factor is 0,91.

Determine the following:

7.1	The phase voltage	(2)
7.2	The line current of the motor in kA	(3)
7.3	The phase current of the motor in kA	(3)
7.4	The value of the angle in degrees	(2)
		[10]

QUESTION 8

A three-phase transformer has a rating of 400 kVA and is connected in delta-star. The input line voltage is 2,4 kV and the output line voltage is 831 volts.

Ignore ALL losses and determine the following:

8.1 The turn ratio (4)

8.2 The input line current (3)

8.3 The output line current (3)
[10]

QUESTION 9

9.1 Give a typical working value of the following types of transformers:

9.1.1 Current transformer (amperes) (1)

9.1.2 Potential transformer (volts) (1)

9.2 Briefly explain, by means of a neat, labelled sketch, how TWO-single phase wattmeters can be used to measure power in a three-phase circuit. (2)

9.3 A current of 80 milli-amperes gives a full-scale reading on an ammeter with an internal resistance of 10 ohms. Determine the resistive values of the shunt resistors to be used for a full-scale reading if:

9.3.1 4 A must flow through the circuit (3)

9.3.2 2 A must flow through the circuit (3)
[10]

QUESTION 10

10.1 Explain, by means of a neat, labelled mechanical sketch, the working principle of a NOR gate. (4)

10.2 Change the following decimal numbers to the binary numbers:

10.2.1 $8{,}4375_{10}$ (2)
10.2.2 61_{10} (2)
10.2.3 $6{,}125_{10}$ (2)
[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. $Efficiency/Rendement = \dfrac{VI}{VI + Ia^2Ra + IsV + C} \times 100$

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

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

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

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

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

PTO

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$\text{I}_{\text{reactive/reaktief}} = \text{I} \sin \theta$

PTO

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

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

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

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

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

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

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

37. $Cos\ \theta = \dfrac{I_R}{I}$

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. $\dfrac{V_1}{V_2} = \dfrac{N_1}{N_2} = \dfrac{I_2}{I_1}$

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

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

44. $I_T = I_m + I_s$

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