higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T580 **(E)**(A4)T

NATIONAL CERTIFICATE

ELECTRO-TECHNOLOGY N3

(11040343)

4 April 2017 (X-Paper)
09:00–12:00

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

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. Sketches and diagrams must be done in pencil. The sketches/diagrams must be neat, reasonably large and fully labelled.
5. The answers must be worked to THREE decimal places after a comma.
6. Use the correct units for answers.
7. Write neatly and legibly.

QUESTION 1

1.1 Give a suitable name for the drawing in FIG.1 (1)

1.2 Name the parts indicated by the arrows in FIG.1.
Write only the answer next to the question number (1.2.1 - 1.2.5) in the ANSWER BOOK. (5)

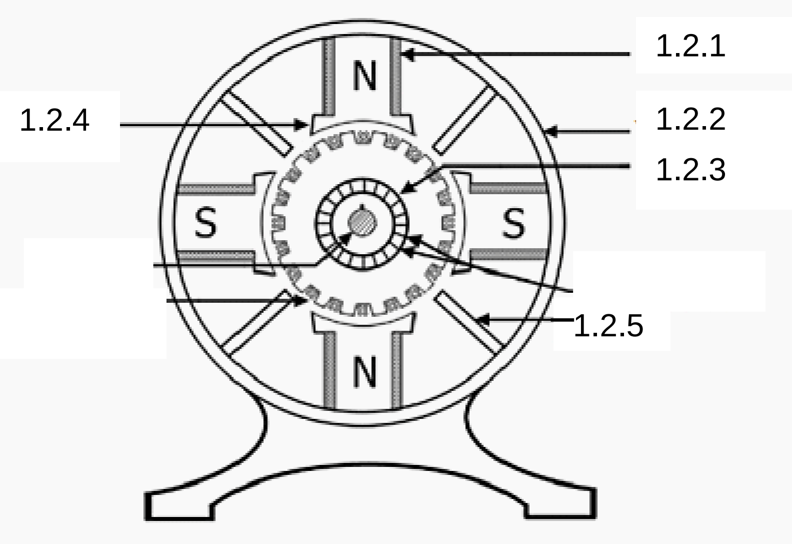

FIG. 1

1.3 Give ONE function of the following:

1.3.1 Part indicated by arrow 1.2.1 (2)

1.3.2 Part indicated by arrow 1.2.4 (2)
[10]

QUESTION 2

2.1 Briefly define *residual magnetism* as applicable to a DC machine. (2)

2.2 The current through the field coils is determined by the supply voltage and the field resistance.

Express this information in terms of a formula. (2)

2.3 Name FOUR uses of a cumulatively compounded motor. (4)

2.4 Name TWO safety devices which are found in a series starter motor. (2)
[10]

QUESTION 3

3.1 State TWO applications of a differentially compounded generator. (2)

3.2 State ONE purpose of a shunt-excited motor. (1)

3.3 A 240 V, 9,6 kW shunt-wound generator has an armature circuit resistance of 0,2 Ω and shunt field of 80 Ω.

Determine the following:

3.3.1 The shunt field current (1)

3.3.2 The line current (1)

3.3.3 The armature current (2)

3.3.4 The generated EMF at full load (3)
[10]

QUESTION 4

4.1 Draw neat, labelled schematic diagrams to show (two methods) how the direction of the following DC motors can be reversed. Also indicate the direction of the armature and field currents in the diagrams

4.1.1 Compound motor (5)

4.1.2 Shunt motor (5)
[10]

QUESTION 5

5.1 An 0,06 MW electric motor draws a current of 175A from a 380V supply.

Determine the following:

5.1.1 The output power (1)

5.1.2 The input power (2)

5.1.3 The efficiency of the motor (3)

5.2 State FOUR main ohmic losses in the current-carrying components of a DC machine. (4)
[10]

QUESTION 6

6.1 A lamp's rating is 160 V, 200 W, coupled to be used on a 230 V, 50 Hz supply. The capacitance must be connected in series with the lamp in order to operate properly.

(HINT: Treat the lamp as purely resistive.)

Determine the following:

6.1.1 Total circuit current (2)

6.1.2 Total voltage (3)

6.1.3 Capacitive reactance (2)

6.1.4 Capacitive value (3)
[10]

QUESTION 7

7.1 A 200 kW, three-phase AC motor, is connected in delta and the supply voltage is 440V. The power factor is 0, 94.

Determine the following:

7.1.1 The line voltage (1)

7.1.2 The line current of the motor in kA (3)

7.1.3 The phase current of the motor in mA (3)

7.2 State THREE disadvantages of low power factor. (3)
[10]

QUESTION 8

8.1 A three-phase transformer has a primary star connection and secondary delta connection. The input line voltage is 190V, and the output line voltage is 3 300V.

Determine the following:

8.1.1 The primary phase voltage (2)

8.1.2 The transformer-ratio (3)

8.1.3 The secondary line current when the primary line current is 600A. (3)

8.2 State TWO purposes of an oil-immersed transformer. (2)
[10]

QUESTION 9

9.1 A galvanometer has a resistance of 100Ω, and gives full-scale deflection when 3 mA passes through it.

Calculate the size of an ammeter to measure up to 1A. (3)

9.2 Briefly describe mutual induction as applicable in a transformer without supporting your description with a sketch. (4)

9.3 State THREE advantages of *damping mechanism.* (3)
[10]

QUESTION 10

10.1 Briefly explain the term *positive voltage level* and support your answer by means of a suitable sketch. (3)

10.2 State ONE function of each of the following components:

10.2.1 Transistor (1)

10.2.2 Diode (1)

10.2.3 Silicon control rectifier (1)

10.3 Draw a switching circuit for a NAND gate. The circuit must include a lamp, battery and switches. (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 = 2pΦ $\frac{ZN}{60c}$

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 Sin2цft

12. i= I_m Sin2цft

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. $E_{ave/gem} = \dfrac{e_1 + e_2 + e_3 + e_4 + \ldots + e_n}{n}$

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

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

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 = 2цfL; i= $\dfrac{V}{X_L}$

21. X_C = 2цfC; 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 θ = $\dfrac{X_C}{R}$

24. V_R = I x 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 θ = $\dfrac{X_L - X_C}{R}$; Tan θ = $\dfrac{X_C - X_L}{R}$

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

28. P = VICosθ

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

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

31. P = VI Cos θ

Q = VI Sin θ

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 = $\frac{\sqrt{3}V_L I_L}{1000}$

43. V $_{shunt/sjunt} = V_{meter}$; I $_s R_s = I_m R_m$

44. I $_T = I_m + I_s$

45. I $_t = \frac{V_t}{R_t}$