higher education
& training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T440**(E)**(N23)T
NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

ELECTRO-TECHNOLOGY N3

(11040343)

23 November 2016 (X-Paper)
09:00–12:00

This question paper consists of 6 pages, 1 diagram sheet 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. The correct information must be copied from the question paper and substituted for the correct symbol.
5. Keep the subsections of questions together, for example QUESTION 1.1.1, 1.2 and so forth. After the completion of each question rule off.
6. Sketches and diagrams must be done in pencil and must 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.

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QUESTION 1

1.1 Define the following terms as applicable in a DC machine:

1.1.1 Commutation (3)

1.1.2 Pole pitch (1)

1.2 Draw a sketch of a DC machine and indicate the following: pole pitch, interpoles and directions of rotation for a motor and a generator. (6)

[10]

QUESTION 2

2.1 Name TWO disadvantages of the commutation process. (2)

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

2.3 State the function of commutation in:

2.3.1 A motor (1)

2.3.2 A generator (1)

2.4 An 8 pole machine has a wave-wound armature with some conductors per slot. The flux per pole is 40 mWb and the EMF generated at 14 r/s is 120V. Determine the total number of conductors in the armature. (4)

[10]

QUESTION 3

3.1 Name TWO losses that torque has to overcome. (2)

3.2 Name TWO variables that the back EMF in a motor depends upon. (2)

3.3 The total torque exerted on an 8 pole motor is 980 Nm. The armature has 660 conductors and carries a current of 400A.

Determine the following:

3.3.1 The flux per pole when connected in the lap wound. (3)

3.3.2 The flux per pole when connected in the wave wound. (3)

[10]

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QUESTION 4

4.1.1 Briefly explain the operation of a bi-metal type overload. (4)

4.1.2 How is time delay obtained in a bi-metal type overload? (1)

4.2 Study FIGURE 1 on the attached DIAGRAM SHEET and answer the following questions. Write only the answer next to the question number (4.2.1– 4.2.5) in the ANSWER BOOK.

4.2.1 Name the type of fluid used in this device indicated by the arrow. (1)

4.2.2 Name the component indicated by the arrow. (1)

4.2.3 Name the component indicated by the arrow. (1)

4.2.4 Name the component indicated by the arrow. (1)

4.2.5 Name the component indicated by the arrow. (1)
[10]

QUESTION 5

5.1 A resistor, inductor and capacitor are connected each in turn (that is not in series or parallel) to a 210V, 60 Hz supply.

Determine the current flows in each turn if the:

5.1.1 Resistor value is 70 000 mΩ (1)

5.1.2 Capacitor value is 130 μF. (2)

5.1.3 Inductor value is 40 mH. (2)

5.2 The components in QUESTION 5.1 are connected in series. Determine:

5.2.1 The circuit impedance (3)

5.2.2 The total current flow through the circuit (2)
[10]

QUESTION 6

An alternating quantity with a maximum value of 40A is represented by a sinusoidal wave and the following mid-ordinate values obtained over a half cycle: $i_1 = 10A$; $i_2 = 20A$; $i_3 = 36A$; $i_4 = 38A$; $i_5 = 28A$; $i_6 = 14A$.

Determine the following:

6.1 The virtual value of the quantity (4)

6.2 The average value of the quantity (3)

6.3 The form factor (1)

6.4 The crest factor (1)

6.5 The kind of wave form which is deduced from the values of the crest factor and form factor. (1)
[10]

QUESTION 7

The inductor is connected in series with a 70W, 140V incandescent lamp so that it can operate from a 200V, 60 Hz supply.

Determine the following:

7.1 The circuit current flow (2)

7.2 The lamp resistance (2)

7.3 The circuit impedance (2)

7.4 The circuit inductance (4)
[10]

QUESTION 8

8.1 State THREE advantages of a three-phase distribution system. (3)

8.2 A three-phase delta connected motor draws a current of 9A from a 380V supply at a power factor of 0,85 lagging.

Determine the following:

8.2.1 The apparent input power in kVA (2)

8.2.2 The actual input power in kW (3)

8.2.3 The phase current of the motor windings (2)
[10]

QUESTION 9

9.1 State FOUR similar components which are found in both a moving-iron and dynamo-meter instrument. (4)

9.2 A galvanometer has a resistance of 120 Ω and gives a full-scale deflection when 6 mA passes through.

Show how the instrument can be used as follows:

9.2.1 A voltmeter capable of measuring between 0 and 6V. (3)

9.2.2 An ammeter to measure up to 2A. (3)
[10]

QUESTION 10

10.1 Indicate the valence number of the following as applicable in an atom:

10.1.1 N-type material (2)

10.1.2 P-type material (2)

10.2 Which electronic component is used for smoothing out the wave in a rectifier circuit? (1)

10.3 State FIVE uses of a silicon-controlled rectifier in electronic circuits. (5)
[10]

TOTAL: 100

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DIAGRAM SHEET

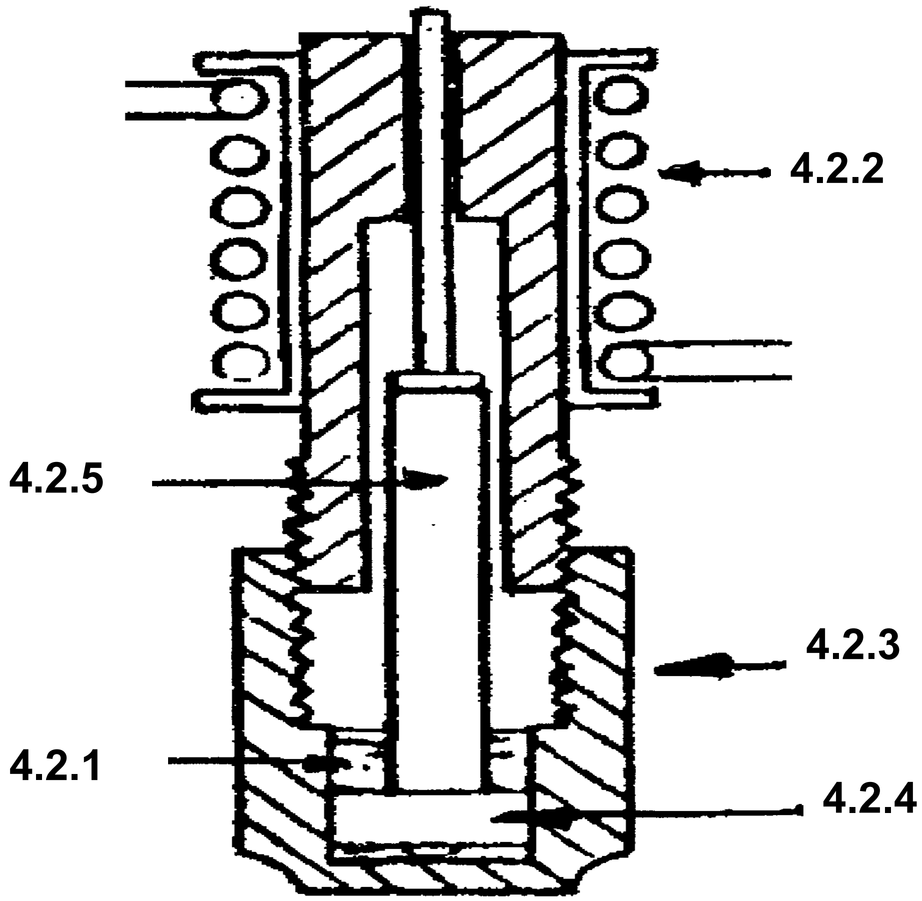

FIGURE 1

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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. $E = 2p\Phi \dfrac{ZN}{60c}$

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

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

6. $\text{Efficiency} = \dfrac{VI}{VI + I_a^{\,2} R_a + I_s V + C} \times 100\%$

7. $\text{Efficiency} = \dfrac{VI - (I_a^{\,2} R_a + I_s V + C)}{VI} \times 100\%$

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

9. $\text{Efficiency} = \sqrt{\dfrac{I_1}{I_1 + I_2}} \times 100\%$

10. E = Blv

11. e = E_m Sin2цft

12. i= I_m Sin2цft

13. $e_{ave/gem}$ or $i_{ave/gem}$ = 0,637 E_m or I_m

14. $e_{rms/wgk}$ or $i_{rms/wgk}$ = 0,707 E_m or I_m

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

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

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

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

17. Form factor = $\dfrac{E_{rms/wgk}}{E_{ave/gem}}$ or $\dfrac{I_{RMS/WGK}}{i_{AVE/GEM}}$

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

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 = $\dfrac{R}{Z}$; Cos θ = $\dfrac{W \text{ or } kW}{VA \text{ or } kVA}$

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30. $I_{active} = ICos\theta$; $\quad I_{reactive} = ISin\theta$

31. P = VI Cos θ

    Q = VI Sin θ

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

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

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

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

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

37. Cos θ = $\dfrac{I_R}{I}$

38. $V_L = V_p$; $I_L = \sqrt{3}I_p$

39. $V_L = \sqrt{3}V_p$; $\quad I_L = I_p$

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. $V_{shunt} = V_{meter}$; $\quad I_s R_s = I_m R_m$

44. $I_T = I_m + I_s$

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

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