



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

ELEKTROTEGNIK N4

26 Julie 2024

Hierdie nasienriglyn bestaan uit 7 bladsye.

VRAAG 1: ELEKTRISITEITSBEGINSELS

- 1.1 1.1.1 A
 1.1.2 B
 1.1.3 E
 1.1.4 D
 1.1.5 A
 1.1.6 C
 1.1.7 A
 1.1.8 B
 1.1.9 E
 1.1.10 A

(10 × 1) (10)

1.2 Data:

$$Q = 170 \text{ MJ}$$

$$V = 230 \text{ V}$$

$$t = 5 \text{ h}$$

$$\therefore t = 5 \times 60 \times 60 = 18\,000 \text{ sek.}$$

$$1.2.1 \quad P = \frac{Q}{t} = \frac{170 \times 10^6}{18\,000} = 9,444 \text{ kW} \checkmark$$

$$I = \frac{P}{V} = \frac{9,444 \times 10^3}{230} = 41,061 \text{ A} \checkmark$$

$$R = \frac{V}{I} = \frac{230}{41,061} = 5,601 \, \Omega \checkmark \quad (3)$$

$$1.2.2 \quad t = 5 \times 25 = 125 \text{ h} \checkmark$$

$$\text{Verbruikte eenhede} = Pt = 9,444 \times 125 = 1\,180,5 \text{ kWh} \checkmark$$

$$\text{Koste} = x \cdot \text{kWh} = 1,75 \times 1\,180,5 = R2\,065,88 \checkmark \quad (3)$$

1.3 $V = 60 \text{ V},$ $R_3 = 15 \Omega$
 $R_1 = 5 \Omega,$ $R_4 = 20 \Omega$
 $R_2 = 10 \Omega,$ $R_L = 25 \Omega$

$$R_T = R_1 + R_2 + \frac{R_3 \times R_4}{R_3 + R_4}$$

$$= 5 + 10 + \frac{15 \times 20}{15 + 20} \checkmark \checkmark$$

$$= 23,571 \Omega \checkmark$$

$$I_T = \frac{V_T}{R_T} = \frac{60}{23,571} = 2,546 \text{ A} \checkmark$$

$$I_N = I_{SC} = \left(\frac{R_3}{R_3 + R_4} \right) I_T$$

$$= \left(\frac{15}{15 + 20} \right) 2,546 \checkmark$$

$$= 1,091 \text{ A} \checkmark$$

$$R_N = R_{SC} = R_4 + \frac{R_3 \times (R_1 + R_2)}{R_3 + (R_1 + R_2)}$$

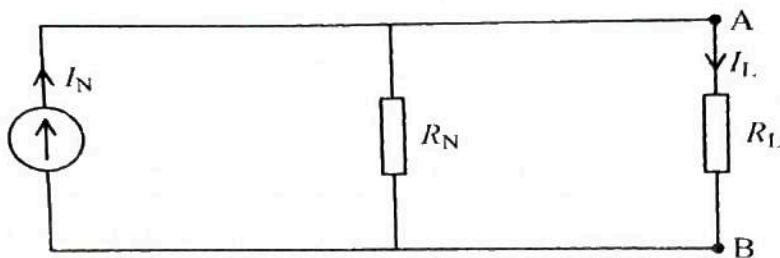
$$= 20 + \frac{15 \times 15}{15 + 15} \checkmark \checkmark$$

$$= 27,5 \Omega \checkmark$$

$$I_L = \left(\frac{R_N}{R_N + R_L} \right) I_N$$

$$= \left(\frac{27,5}{27,5 + 25} \right) 1,091 \checkmark$$

$$= 0,571 \text{ A} \checkmark$$



Elke simbool ($\frac{1}{2} \times 3$)

Elke etiket ($\frac{1}{2} \times 3$)

(14)
[30]

VRAAG 2: GELYKSTROOMMASJIENE

- 2.1 A – As
 B – Koelingswaaier
 C – Ankerkern
 D – Ankerwikkelings
 E – Kommutator
 F – Laer
 G – Ankergeleiers (7)

- 2.2 Data:
 $p = 4$
 $c = 8$
 $\beta = 1,4 \text{ Wb/m}^2$
 $d = 60 \text{ cm} = 0,6 \text{ m}$
 $L_c = 1,2$
 $Z = 650$
 $N = 350 \text{ r/m}$

$$a = \frac{\pi d^2}{4}$$

$$= \frac{\pi \times 0,6^2}{4} = 0,283 \text{ m}^2 \checkmark$$

$$\phi = a \times \frac{\beta}{L_c}$$

$$= 0,283 \times \frac{1,4}{1,2} \checkmark$$

$$= 0,330 \text{ Wb} \checkmark$$

$$E = \frac{2p\phi ZN}{60c}$$

$$= \frac{2 \times 4 \times 0,330 \times 650 \times 350}{60 \times 8} \checkmark$$

$$= 1251,25 \text{ V} \checkmark$$

(5)

2.3

Data:

$$I_L = 65 \text{ A}$$

$$R_a = 0,1 \Omega$$

$$R_{se} = 0,025 \Omega$$

$$R_{sh} = 55 \Omega$$

$$E = 248 \text{ V}$$

$$V = ?$$

$$I_{sh} = \frac{V}{R_{sh}}$$

$$I_a = I_L + I_{sh}$$

$$V = E - I_a(R_a + R_{se}) \checkmark$$

$$V = E - (I_L + I_{sh})(R_a + R_{se}) \checkmark$$

$$V = E - (I_L + \frac{V}{R_{sh}})(R_a + R_{se}) \checkmark$$

$$V = 248 - (65 + \frac{V}{55})(0,1 + 0,025) \checkmark$$

$$V = 248 - (65 + \frac{V}{55})(0,125) \checkmark$$

$$V = 248 - (8,125 + \frac{0,125V}{55}) \checkmark$$

$$V = 248 - (8,125 + 0,00227 V) \checkmark$$

$$V = 239,875 - 0,00227 V \checkmark$$

$$1,00227 V = 239,875$$

$$V = 239,332 \text{ V} \checkmark$$

(8)
[20]

VRAAG 3: WISSELSTROOMTEORIE

3.1

- Verbruikers betaal duurder vir dieselfde las.
- Dikker kables moet gebruik word.
- Verhoogde I^2R -verliese.
- Dit beperk die lewering van generators sowel as transformators.
- Masjiene word minder doeltreffend.
- Toevoerkables oorverhit.
- Oorstroom kom voor in kring.
- Krag word duurder.

(Enige 5 × 1)

(5)

3.2

Gegewe:

$$Z_1 = 5 + j9,$$

$$Z_2 = -8 - j12$$

$$Z_1 = 5 + j9 = 10,296 \angle 60,945^\circ \Omega$$

$$Z_2 = -8 - j12 = 14,422 \angle -123,69^\circ \Omega$$

$$\begin{aligned} 3.2.1 \quad Z_1 + Z_2 &= 3 - j3 \checkmark \\ &= 4,243 \angle -135^\circ \Omega \checkmark \end{aligned}$$

(2)

$$\begin{aligned} 3.2.2 \quad Z_1 - Z_2 &= 13 + j21 \checkmark \\ &= 24,698 \angle 58,241^\circ \Omega \checkmark \end{aligned}$$

(2)

$$\begin{aligned}
 3.2.3 \quad Z_1 \times Z_2: \\
 Z_1 &= 5 + j9 = 10,296 \angle 60,945^\circ \Omega \checkmark \\
 Z_2 &= -8 - j12 = 14,422 \angle -123,69^\circ \Omega \checkmark \\
 Z_1 \times Z_2 &= 148,489 \angle -62,745^\circ \Omega \checkmark \quad (3) \\
 3.2.4 \quad Z_1 \div Z_2 &= 0,714 \angle 184,635^\circ \Omega \checkmark \quad (1) \\
 3.2.5 \quad 13 \cdot Z_2 &= 13 \angle 0^\circ \cdot 14,422 \angle -123,69^\circ \checkmark \\
 &= 187,486 \angle -123,69^\circ \Omega \checkmark \quad (2) \\
 3.2.6 \quad \frac{5}{Z_1} &= \frac{5 \angle 0^\circ}{10,296 \angle 60,945^\circ} \checkmark \\
 &= 0,486 \angle -60,945^\circ \Omega \checkmark \quad (2) \\
 3.2.7 \quad x \text{ as } x &= \frac{Z_1 \times Z_2}{Z_1 + Z_2} \\
 x &= \frac{148,489 \angle -62,745^\circ}{4,243 \angle -135^\circ} \checkmark \\
 &= 34,996 \angle 72,255^\circ \checkmark \\
 &= 10,666 + j33,331 \checkmark \quad (3)
 \end{aligned}$$

[20]

VRAAG 4: TRANSFORMATORS

- 4.1
- Dit dien as 'n koelmiddel.
 - Dit voorkom boogvorming.
 - Dit dien as 'n sekondêre isolasie.
 - Dit dien as 'n versperring tussen die papierisolasie en atmosferiese suurstof.
- (4)

4.2 Data:

$$\begin{aligned}
 V_1 &= 48 \text{ V} \\
 V_2 &= 480 \text{ V} \\
 f &= 50 \text{ Hz} \\
 A &= 10 \text{ cm}^2 = 10 \times 10^{-4} \text{ m}^2 \\
 \beta &= 1,8 \text{ T}
 \end{aligned}$$

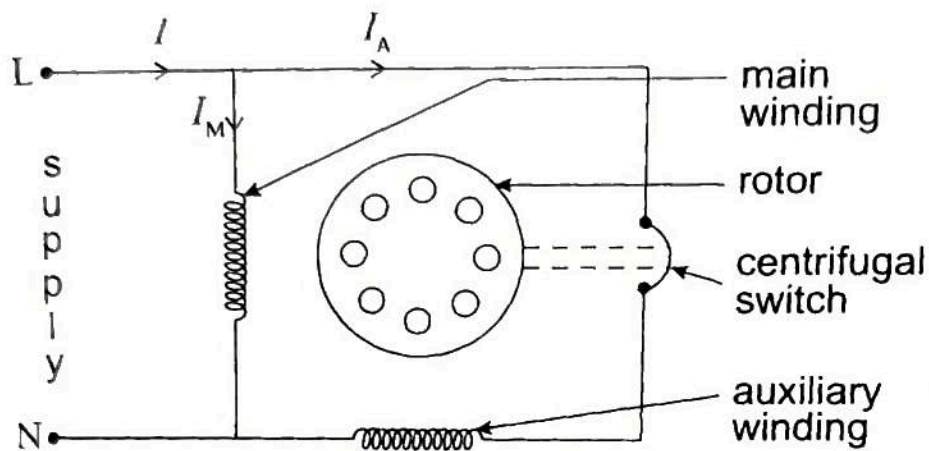
$$\begin{aligned}
 \phi_m &= \beta A \\
 &= 1,8 \times 10 \times 10^{-4} \checkmark \\
 &= 0,0018 \text{ Wb} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 N_1 &= \frac{E_1}{4,44 f \phi_m} \\
 &= \frac{48}{4,44 \times 50 \times 0,0018} \checkmark \\
 &= 120 \text{ windings} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 N_2 &= \frac{V_2 \times N_1}{V_1} \\
 &= \frac{480 \times 120}{48} \checkmark \\
 &= 1200 \text{ windings} \checkmark
 \end{aligned}$$

VRAAG 5: WISSELSTROOMMASJIENE

5.1



(Diagram 2 × 1)

(Byskrifte 3 × 1)

(5)

5.2

- Handbore
- Slypmasjiene
- Naaimasjiene
- Stofsuiers
- Voedselverwerkers
- Mengers

(Enige 5 × 1)

(5)

[10]

VRAAG 6: OPWEKKING EN TOEVOER VAN WISSELSTROOMKRAAG EN MEETINSTRUMENTE

6.1

Turbine

(1)

6.2

- Opwekking
- Transmissie
- Distribusie
- Benutting

(4)

6.3

- A – Toevoer
- B – Potensiaaltransformator
- C – Stroomtransformator
- D – Stroomspoel
- E – Spanningspoel

(5)

[10]

TOTAAL:

100