higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

ELEKTROTEGNIEK N4

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Hierdie nasienriglyn bestaan uit 9 bladsye.

Kopiereg voorbehou

VRAAG 1: BEGINSELS VAN ELEKTRISITEIT

1.1
1.1.1 Waar
1.1.2 Waar
1.1.3 Onwaar
1.1.4 Waar
1.1.5 Onwaar
1.1.6 Onwaar
1.1.7 Onwaar
1.1.8 Waar
1.1.9 Waar
1.1.10 Waar

(10 × 1) (10)

1.2 **Gegee:**

$R_1 = 7\Omega$
$R_2 = 5\Omega$

$E_1 = 1,5V$
$r_1 = 1,2\Omega$

$E_2 = 1,1V$
$r_2 = 0,7\Omega$

1.2.1

$$R_T = \frac{R_1 x R_2}{R_1 + R_2} = \frac{(7x5)}{(7+5)} = 2,92\Omega \checkmark$$

$$r_T = r_1 + r_2 = 1,2 + 0,7 = 1,9\Omega \checkmark$$

$$E_T = E_1 + E_2 = 1,5 + 1,1 = 2,6V \checkmark$$

$$E = I(R_T + r_T)$$
$$2,6 = I(2,92 + 1,9)$$
$$I = 0,539A \checkmark$$

ALTERNATIEWE OPLOSSING:

$$Rt = \frac{R1xR2}{R1 + R2}$$
$$= \frac{7x5}{7+5} + 1,2 + 0,7 \checkmark$$
$$= 4,817\Omega \checkmark$$

$$It = \frac{Et}{Rt} = \frac{2,6}{4,817} = 0,54A \checkmark\checkmark$$

Die stroom deur albei selle is gelyk (I = 0,54 A) aangesien dit 'n seriekoppeling is. (4)

Kopiereg voorbehou

1.2.2 ET = V + IT Rt Maar Rp = Rt

V = 2,6 – 0,536 (1,9)

= 1,582 V ✓

OF

$V_p = I_p R_p = 0,539x2,92 = 1,574V$ ✓

$I_{R_1} = \frac{V_p}{R_1} = \frac{1,574}{7} = 0,225A$ ✓

$I_{R_2} = \frac{V_p}{R_2} = \frac{1,574}{5} = 0,315A$ ✓ (3)

1.2.3 $E_1 = V_1 + Ir_1$

$1,5 = V_1 + (0,539x1,2)$

$V_1 = 0,853V$ ✓

$E_2 = V_2 + Ir_2$

$1,1 = V_2 + (0,539x0,7)$

$V_2 = 0,723V$ ✓ (2)

1.3 **Gegee:**

I_1 = 4.1 A

t = 60º

ø = 20º

V = 230 V

α_0 = 0,004/ºC

$R_t = R_ø [1 + \alpha_0 (t - ø)]$

$R_ø = \frac{V}{I1} = \frac{230}{4.1} = 56,098\ \Omega$ ✓

$R_t = 56,098[1 + (0,004)(60° - 20°)]$ ✓

= 65,074 Ω ✓

$I_2 = \frac{V}{Rt} = \frac{230}{65,074} = 3,534\ \Omega$ ✓

$\therefore\ \Delta I = I1 - I2 = 4,1 - 3,534 = 0,566\ A$ ✓ (5)

1.4 **Gegee:**

$C_1 = 15\mu F$

$V = 60\ V$

$C_2 = 5\ \mu F$

1.4.1 $Q_1 = VC_1 = 60 \times 15 = 900\ \mu C$ ✓

$Q_T = Q_1 + Q_2 = 900 + 0 = 900\ \mu C$ ✓

$C_T = C_1 + C_2 = 15 + 5 = 20\ \mu F$ ✓

$V = \frac{Qt}{Ct} = \frac{900}{20} = 45V$ ✓ **OR** $Q_T = Q_1 + Q_2$

$Q_T = VC_1 + VC_2$

$Q_T = V(C_1 + C_2)$

$900 = V(20)$

$V = 45\ V$ ✓ (4)

1.4.2 $Q_1 = VC_1 = 45\ (15) = 675\ \mu C$ ✓

$Q_2 = VC_2 = 45\ (5) = 225\ \mu C$ ✓ (2)

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VRAAG 2: GS-MASJIENE

2.1 **Ankerreaksie:**
Is die distorsie van die hoofvloed wat die anker ingaan en verlaat, wat veroorsaak word deur die vloed wat deur die ankergeleiers daargestel word wanneer dit stroom dra. (2)

2.2 **Gegee:**

p = 3

c = 2p

IL = 50 A

V = 240 V/50Hz

Z = 864 met Rsh = 0,1 ohm

$\phi = 50x10^{-3}Wb$

$R_{sh} = 120\Omega$

$$I_{sh} = \frac{V}{R_{sh}} = \frac{240}{120} = 2A \checkmark$$

$$I_a = I_L + I_{sh} = 50 + 2 = 52A \checkmark$$

$$E = V + IaRa$$
$$= 240 + (52x0,1) \checkmark$$
$$= 245,2V \checkmark$$

$$E = \frac{2ZNp\emptyset}{60c}$$

$$\therefore N = \frac{60cE}{2Zp\phi} = \frac{60x2x3x245,2}{2x864x3x50x10^{-3}} \checkmark\checkmark$$

N = 340 r/m ✓ (7)

2.3 **Gegee:**

$I_L = Ise = 65\ A$

$Rsh = 220\ \Omega$

$V = 400\ V$

$Rse = 0,1\ \Omega$

$Ra = 0,15\ \Omega$

$E = 420\ V$

$E = V + IaRa + IseRse + IaRb$ ✓

$Vse = IseRse = (65)(0,1) = 6,5\ V$ ✓

$Vsh = V - Vse = 400 - 6,5 = 393,5\ V$ ✓

$Ish = \frac{V}{Rsh} = 1,819\ A$ ✓

$Ia = Ish + Ise = 1,819 + 65 = 66,819\ A$ ✓

$IaRb = E - V - IaRa - IseRse$ ✓

$= 420 - 400 - (66,819)(0,15) - (65)(0,1)$ ✓

$= 3,477\ V$ ✓ (8)

2.4 **Gegee:**

$V = 500V$

$R_a = 0,2\Omega$

$R_{st} = ?$

$I_{a(start)} = 125\%of100 = 125A$ ✓ **OF** **Ia(start) = 1,25 X100 = 125 A** ✓

$$I_{a(start)} = \frac{V}{R_a + R_{st}}$$

$$\therefore R_{st} = \frac{V}{I_{a(st)}} - R_a$$

$$= \frac{500}{125} - 0,2$$ ✓

$= 3,8\Omega$ ✓

(3)
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VRAAG 3: WS-TEORIE

3.1 **Effektiewe waarde van 'n wisselstroom:**
Is daardie waarde van 'n wisselstroom wat dieselfde hoeveelheid warmte-energie teen dieselfde tempo produseer as wat 'n gelykstroom sou, indien dit deur 'n identiese weerstand sou vloei. (2)

3.2

3.2 3.2.1 **Vir spoel A:**

$X_{LA} = 2\pi fL = 2\pi \times 50 \times 200 \times 10^{-3}$= 62,832 Ω ✓

$Xc = \frac{1}{2\pi fC} = \frac{1}{2\pi \times 50 \times 55 \times 10^{-6}} = 57{,}875\Omega$ ✓

$Z_A = R + jXL = 36 + j62{,}832 = 72{,}415 < 60{,}819°$ ✓

$Z_{cap} = R - jXc = 30 - j57{,}875 = 65{,}188 < -62{,}6°$ ✓

$Z_A + Z_{cap} = 66 + j4{,}957 = 66{,}186 < 4{,}294°$ ✓

$Zp = \frac{Za \times Zcap}{Za + Zcap} = 71{,}323 < -6{,}706°$ Ω ✓✓

Vir spoel B:

$X_{LB} = 2\pi fL = 2\pi \times 50 \times 100 \times 10^{-3} = 31{,}416\,\Omega$ ✓

$Z_B = 20 + j31{,}416 = 37{,}242 < 57{,}158°$ ✓

$Zt = Zp + Zb = 90{,}835 + j23{,}087 = 93{,}723 < 14{,}261°$ ✓✓

$It = \frac{Vt}{Zt} = \frac{200 < 0°}{93{,}723 < 14{,}261} = 2{,}134 < -14{,}261A$ ✓ (12)

3.2.2 $V_{coilA} = I_t Z_p$
$= 2{,}134 < -14{,}261 \times 71{,}323 < -6{,}706°$ =152,203<-20,967º V ✓✓

$V_{coilB} = I_t Z_B$
$= 2{,}134 < -14{,}261 \times 37{,}242 < 57{,}158 = 79{,}474 < 43{,}257^0\ V$ ✓✓ (4)

3.2.3 $I_A = \frac{Vp}{Zb} = 2{,}102 < -81{,}156°\ A$ ✓

$Icap = \frac{Vp}{Zcap} = 2{,}335 < 41{,}633°$ A ✓ (2)

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VRAAG 4: TRANSFORMATORS

4.1 a) Kerntipe met konsentriese wikkelings
b) Manteltipe met toe-wikkelings ('sandwich windings') (2)

4.2 **Gegee:**

$f = 50Hz$

$N_1 = 20turns$

$N_2 = 273turns$

$A = 400cm^2 = (400x10^{-2})^2 m^2 = 400x10^{-4} m^2$

$E_1 = 220V$

4.2.1

$E = 4,44\phi_m fN$

$220 = 4,44\phi_m x50x20$ ✓

$\phi_m = 0,0495Wb$ ✓

$$B_m = \frac{\phi_m}{A}$$

$$= \frac{0,0495}{400x10^{-4}}$$ ✓

$= 1,238T$ ✓

(4)

4.2.2

$$\frac{V_1}{V_2} = \frac{N_1}{N_2}$$

$$\frac{220}{V_2} = \frac{20}{273}$$ ✓

$V_2 = 3003V$ ✓ (2)

4.2.3 $Voltage/_{Turn} = \frac{V1}{N1} = \frac{220}{20} = 11\ v/t$ ✓✓ (2)

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VRAAG 5: WS-MASJIENE

5.1 Die entplate van 'n motor
- is aan elke ent van die stator gemonteer
- sluit die laers in
- en hou die rotor relatief tot die stator in posisie (3)

5.2 a) Weerstand-aansit-induksiemotor
b) Kapasitor-aansit-induksiemotor
b) Kapasitor-aansit-kapasitor-loop-induksiemotor (3)

5.3 Aansitwikkeling:

- Beskik oor dunner geleiers.
- Is bo op die loopwikkeling.
- Beskik oor hoë weerstand en lae induktansie.

Loopwikkeling:

- Beskik oor dikker geleiers.
- Aan die onderkant van die gleuwe.
- Beskik oor lae weerstand en hoë induktansie.

Enige twee vir elke wikkeling (2 × 2) (4)
[10]

VRAAG 6: OPWEKKING EN VOORSIENING VAN WS-KRAG EN MEETINSTRUMENTE

6.1 a) Steenkoolkragstasies en
b) Kernkragstasies (2)

6.2 a) Om vervoerkoste te verminder.
b) Om ernstige verkeersprobleme op die paaie te voorkom.
c) Om besoedeling weg van dig bevolkte gebiede te hou. (3)

6.3 Gegee:

$Rsh = 0{,}25\ \Omega$
$Rse = 15\ k\Omega$
$Rm = 300\ \Omega$
$Im = 13{,}5\ mA$

$$Ish = \frac{ImRm}{Rsh} = \frac{(13{,}5x10^{-3})(300)}{(0{,}25)} = 16{,}2\ A$$ ✓✓

$$I = Ish + Im = 16{,}2 + 13{,}5x10^{-3} = 16{,}214\ A$$ ✓

$$Rse = \frac{V}{Im} - Rm$$
$$V = Im(Rm + Rse) = 13{,}5x10^{-3}(300 + 15x10^{3}) = 206{,}55\ V$$ ✓✓ (5)
[10]

TOTAAL: 100

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