higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

ELEKTROTEGNIEK N5

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Hierdie nasienriglyn bestaan uit 6 bladsye.

Kopiereg voorbehou

VRAAG 1

1.1
- Hulle fasiliteer die versameling van stroom uit die ankergeleiers.
- Hulle sit die wisselende EMK (WS) wat in die ankergeleiers geïnduseer word in eenrigting- EMK (GS) om. (2)

1.2 1.2.1
$E = V - I_aR_a$
$= 480 - (45 \times 0,36)$
$= 463,8\ V$✓

$\phi = 60\ cE/2\ PNZ$
$= (60 \times 4 \times 463,8)/(2 \times 2 \times 980 \times 2\ 050)$✓
$= 111\ 312 / 8\ 036\ 000$
$= 0,01385\ Wb$✓
$= 13,852\ mWb$

1.2.2
$T = 0,318\ I_a\ ZP\ \phi/c$
$= (0,318 \times 45 \times 2\ 050 \times 2 \times 0,01385)$✓/4✓
$= 203,148\ Nm$✓

(2 × 3) (6)

1.3
$E_1 = V - I_aR_a$
$= 500 - (110 \times 0,25)$✓
$= 472,5\ V$✓

$T_2 = 0,8\ T_1$
$N_2 = 0,75\ N_1$
$\phi_2 = \phi_1$✓

$E_2/E_1 = \phi_2\ N_2/\phi_1\ N_1$
$E_2 = 0,75 \times 472,5$✓
$= 354,375\ V$✓

$T_2/T_1 = \phi_2\ I_{a2}/\phi_1\ I_{a1}$
$0,8 = I_{a2}/110$ ✓
$I_{a2} = 0,8 \times 110$ ✓
$= 88\ A$ ✓

$E_2 = V - I_{a2}\ (R_a + R_X)$
$354,375 = 500 - 88(0,25 + R_X)$✓
$1,655 = 0,25 + R_X$
$R_X = 1,405\ \Omega$✓ (10)

1.4
- Redelik konstante spoed
- Swak aanvangsdraaimoment (2)

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VRAAG 2

2.1 2.1.1 $Z = 844 < 45/12 < -45$
$= 70,333 < 90°$✓

Omvang:
$X_L = 70,333\ \Omega$✓

Aard:
Suiwer induktansie✓ (3)

2.1.2 $314 = 2\pi f$
$F = 314/(2\pi)$
$= 49,975$ Hz✓

$T = 1/f$
$= (49,975)^{-1}$
$= 0,02$ s
$= 20$ ms✓ (2)

2.2 2.2.1 $P_T = V_T I_T \cos \Theta$
$I_T = P_T/(V_T \cos \Theta)$
$= 3\ 300/220$✓
$= 15$ A
$= 15 < 0$ A✓

$X_B = (2\pi \times 50 \times 145 \times 10^{-6})^{-1}$
$= 21,952\ \Omega$✓
$Z_B = 5 - j21,952$
$= 22,514 < -77,17\ \Omega$✓

$I_B = 220 < 0°/22,514 < -77,17$✓
$= 9,772 < 77,17$ A ✓

$I_A = I_T - I_B$
$= 15 + j0 - 2,169 - j9,528$✓
$= 12,831 - j9,528$✓
$= 15,982 < -36,59$ A✓

$Z_A = V_T / I_A$
$= 220 < 0/15,982 < -36,59$✓
$= 13,765 < 36,59\ \Omega$✓
$= 11,052 + j8,205$
$X_A = 8,205\ \Omega$✓
$R_A = 11,052\ \Omega$✓

OF

$Z_T = V_T/I_T$
$= 220 < 0/15 < 0$✓
$= 14,667 < 0^0\ \Omega$✓

$Z_A = Z_T Z_B/(Z_B - Z_T)$
$= 14,667 < 0 \times 22,514 < -77,17$✓$/(5 - j21,952 - 14,667 - j0)$✓
$= 330,213 < -77,17$ ✓$/(-9,667 - j21,952)$✓
$= 330,213 < -77,17/23,986 < -113,77$✓
$= 13,767 < 36,6\ \Omega$✓
$= 11,052 + j8,208$✓
$R_A = 11,052\ \Omega$✓
$X_A = 8,208\ \Omega$✓ (13)

2.2.2 $\cos \Theta = \cos 36,59$✓
$= 0,803$, nalopend✓ (2)
[20]

VRAAG 3

3.1
- Dieselfde spanningsverhouding
- Dieselfde per-eenheid- of persentasie impedansie
- Dieselfde polariteit
- Dieselfde fasevolgorde en zero- relatiewe faseverskuiwing (4)

3.2 Ja
Die stroom in die primêre wikkeling lewer 'n baie klein kragkomponent om die ysterverlies in die kern te voorsien. (2)

3.3 3.3.1 $S_T = P_T/\cos \Theta$
$= 1,2 \times 10^6/0,85$✓
$= 1\ 411,765$ kVA✓

$Z_1 = (2,5 + j5,5)\ 1\ 800/1\ 400$
$= 3,214 + j7,071$
$= 7,767 < 65,56\ \Omega$✓

$Z_2 = 1,6 + j3,5$
$= 3,848 < 65,43\ \Omega$✓
$Z_1 + Z_2 = 4,814 + j10,571 = 11,616 < 65,52\ \Omega$✓

$S_1 = (1\ 411,765 < -31,79 \times 3,848 < 65,43)$✓$/11,616 < 65,52$
$= 5\ 432,472 < 33,64/11,616 < 65,52$
$= 467,672 < -31,88$ kVA
$= 467,672$ kVA✓
$\cos \Theta = \cos 31,88 = 0,849$ nalopend✓ (8)

3.3.2 S_2 = (1 411,765 < -31,79 x 7,76 < 65,56) ✓/11,616 < 65,52✓
= 10 955,296 < 33,77 ✓/11,616 < 65,52
= 943,121 < -31,75 kVA
= 943,121 kVA✓

Cos Θ = Cos 31,75 ✓= 0,85 nalopend✓ (6)
[20]

VRAAG 4

4.1 4.1.1 $X_L = 2\pi \times 50 \times 0,04 = 12,566\ \Omega$✓
$Z_P = 12 + j12,566 = 17,375 < 46,32\ \Omega$✓

$I_P = V_P/Z_P$ = 415 < 0/17,375 < 46,32✓
= 23,885 < -46,32 A ✓
$I_L = \sqrt{3}\ I_P = \sqrt{3} \times 23,885$ ✓ = 41,369 A✓ (6)

4.1.2 CosΘ = Cos 46,32 = 0,691 nalopend✓ (1)

4.1.3 $P = \sqrt{3}\ V_L\ I_L\ Cos\Theta = \sqrt{3} \times 415 \times 41,369 \times 0,691$✓
= 20 547,633 W = 20,548 kW✓ (2)

4.2 4.2.1 $V_P = 12 \times 10^3/\sqrt{3} = 6\ 928,203$ V✓

$V_R = V_P(Cos\Theta + jSin\Theta) = 6\ 928,203(0,78 + j0,626)$
= 5 403,998 + j4 337,055✓

$I_P = S/\sqrt{3}\ V_L = 3 \times 10^6/(\sqrt{3} \times 12 \times 10^3) = 144,338$ A✓

$V_d = I_P\ Z = 144,338(5 + j10) = 721,688 + j1\ 443,38$✓

$V_S = V_R + V_d$ = 5 403,998 + j4 337,055 + 721,688 + j1 443,38✓
= 6 125,686 + j5 780,435 = 8 422,438 < 43,34 V✓

Reg = $(V_S - V_R)/V_R$ = (8 422,438 – 6 928,203) /6 928,203 × 100✓
= 21,567%✓ (8)

4.2.2 Verliese = $3\ (I_P)^2\ R_P = 3(144,338)^2 \times 5 = 312\ 501,874$ W
= 31,25 kW✓

$\eta = P_O/(P_O + loss) = 2,34 \times 10^6/(2,34 \times 10^6 + 31,25 \times 10^3)$✓
= 98,682%✓ (3)
[20]

VRAAG 5

5.1 Soeking is 'n skielike verandering van las op sinchrone motors, soms opgestelde ossilasies wat op die normale rotasie gesuperponeer word, en aanleiding gee tot periodieke variasies in spoed van 'n baie lae frekwensie. (2)

5.2 $N_S = 60f/p = (60 \times 50)/4$ ✓ $= 750$ r/min✓

$S = (N_S - N_R)/N_S$

$0,04 = (750 - N_R)/750$✓

$N_R = 750 - (750 \times 0,04)$

$= 720$ r/min✓ (4)

5.3 5.3.1 $E_R = E_A + E_B < (180 - \alpha) = 1\,910 < 0 + 1\,800 < 150$

$= 1\,910 + j0 - 1\,558,846 + j900$✓

$= 351,154 + j900$

$= 966,079 < 68,69$ V✓

$Z_R = 0,4 + j9 = 9,009 < 87,46\ \Omega$ ✓

$I_R = E_R/Z_R = 966,079 < 68,69/9,009 < 87,46$✓

$= 107,235 < -18,77$ A✓ (5)

5.3.2 $V_{TER} = (E_A + E_B)/2 = (1\,910 + j0 + 1\,558,846 - j900)$ ✓/2

$= (3\,468,846 - j900)/2$

$= (3\,583,698 < -14,54)/2$

$= 1\,791,849 < -14,54$ V✓

$V_L = \sqrt{3} \times 1\,791,849 = 3\,103,574$ V✓ (3)

5.4 5.4.1 $E_O = 110/\sqrt{3} = 63,509$ V✓

$Z_O = 2,6 + j7,5 = 7,938 < 70,88\ \Omega$✓

$I_R = E_O/Z_O = 63,509/7,938 = 8$ A✓ (4)

5.4.2 $\text{Cos}\Theta = \text{Cos}\ (70,88)$✓ $= 0,328$✓

OF

$\text{Cos}\Theta = \text{Cos}[\tan^{-1}\ (7,5/2,6)]$✓ $= 0,328$✓ (2)

[20]

TOTAAL: 100

Kopiereg voorbehou