higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

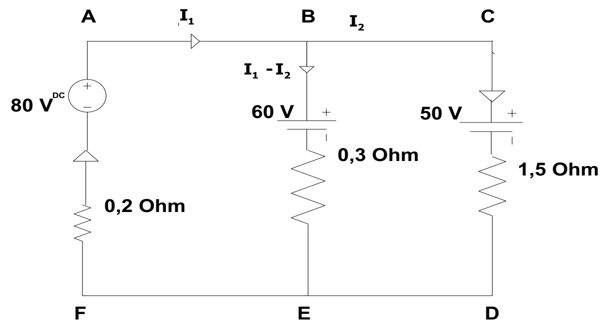
ELECTROTECHNICS N4

30 NOVEMBER 2016

This marking guideline consists of 7 pages.

QUESTION 1

1.1



Consider loop:ABEFA :loop:ACDFA

$\sum E - \sum IR = 0$ $\sum E - \sum IR = 0$

$$\mathbf{(E_1 - E_2) - (I_1R_1 + (I_1R_2 - I_2R_2)) = 0}$$

$$\mathbf{(80 - 60) - (0{,}2I_1 + (0{,}3I_1 - 0{,}3I_2) = 0} \checkmark$$

$$\mathbf{20 - 0{,}5I_1 + 0{,}3I_2 = 0 ....(1)}$$

$$\mathbf{(E_1 - E_3) - [I_1R_1 + R_3I_2] = 0}$$

$$\mathbf{(80 - 50) - (0{,}3I_1 + 1{,}5I_2) = 0} \quad \checkmark$$

$$\mathbf{30 - 0{,}3I_1 - 1{,}5I_2 = 0........ ....(2)}$$

Eq./Verg.(1) x (5) = $100 - 2{,}5\mathbf{I_1} + 1{,}5\mathbf{I_2} = 0$ ✓...............(3)

Add (2) and (3) = $130 - 2{,}8\mathbf{I_1} = 0$

Thus: $\mathbf{I_1}$ = 130/2,8 = 46,43 A✓

Substitude $\mathbf{I_1}$ = 10 A into Eq. (1)

20– 0,5(46,43) + 0,3$\mathbf{I_2}$ = 0

-$\mathbf{I_2}$ =20 – 23,2143/0,3 = -3,2143/0,3

-$\mathbf{I_2}$ = - 10,7143A Thus ✓

$\mathbf{I_2}$ = 10,7143 A

$\mathbf{I_1 - I_2 = 35{,}7143\ A}$

1.1.1 $\mathbf{I_1}$ = 46,43 A from pos. to neg. ✓

1.1.2 $\mathbf{I_1 - I_2 = 10{,}7143\ A}$ from neg.to pos. ✓

1.1.3 $\mathbf{I_2}$ = 10,7143 from neg. to pos. ✓

(8)

1.2 $P = I^2 R$

$1000 = 100 R$

$R = \underline{10\ \Omega}$ ✓x

$\therefore\ V_{SE} = IR_{SE}$ $= 10x10$ $= \underline{100V}$ ✓ $V_P = V_T - V_{SE}$ $=190 – 100$ $= \underline{90\ V}$ ✓ $I = V/R$ $= 90/15$ $= \underline{6\ A}$ ✓

$I = 10 - 6 = 4\ A$ ✓

Maar $V_P = 90\ V$

$\therefore\ R_X = \frac{V_P}{I} = \frac{90}{4} = 22,50\ \Omega$ ✓✓ (7)

1.3 The type of material used, and the heat treatment and the mechanical handling to which the specimen has been subjected. (3)

1.4 They are almost unaffected by temperature. (2)

[20]

QUESTION 2

2.1 2.1.1 $C_S = 8 + 10 = 18\ \mu F$ ✓✓

2.1.2 $Q_T = Q_1 = Q_2 = VC = 20 \times 18\ \mu F = \underline{360\ \mu C}$ ✓✓

$V = Q/C = 360/8\ \&\ 360/10$

$= 45\ V$ ✓ & $36\ V$ ✓

(6)

2.2 Air, Paper, Mica, Ceramic, Polycarbonate, Electrolytic (Any 3 × 1) (3)

2.3 2.3.1 $I_a = I_T - I_C$

$= 350 - 150$ ✓

$= 200\ A$

$A_a = \frac{\pi d_a^2}{4} = \frac{\pi(20x10^{-3})^2}{4} = 3,141592654x10^{-4} m^2$ ✓✓

$R_a = \frac{P_a x L_a}{A_a}$ but

$= \frac{0,028x10^{-6}x500}{3,141592654x10^{-4}}$ ✓

$= 0,04456338407\Omega$

$d = \sqrt{\frac{4P_C L_C}{\pi R_C}} = \sqrt{\frac{4x0,017x10^{-6}x500}{\pi(0,05941784542)}} = 13,496\ mm$ ✓✓ (6)

2.3.2 $\mathbf{V_a = I_a R_a}$

$= \mathbf{200 x 0,04456338407}$ ✓

$= \mathbf{8,912676813\ V}$

$\mathbf{R_C = \frac{V_C}{I_C} = \frac{8,912676813}{150} = 0,05941784542\ \Omega}$ ✓

(2)

2.4 $\mathbf{R_t = R\ [1 + \alpha\ (t_1 - t_2)]}$

$\mathbf{232 = 200[1 + \alpha(100° - 60°)]}$ ✓✓✓

$\mathbf{232 = 200[1 + \alpha(40)]}$

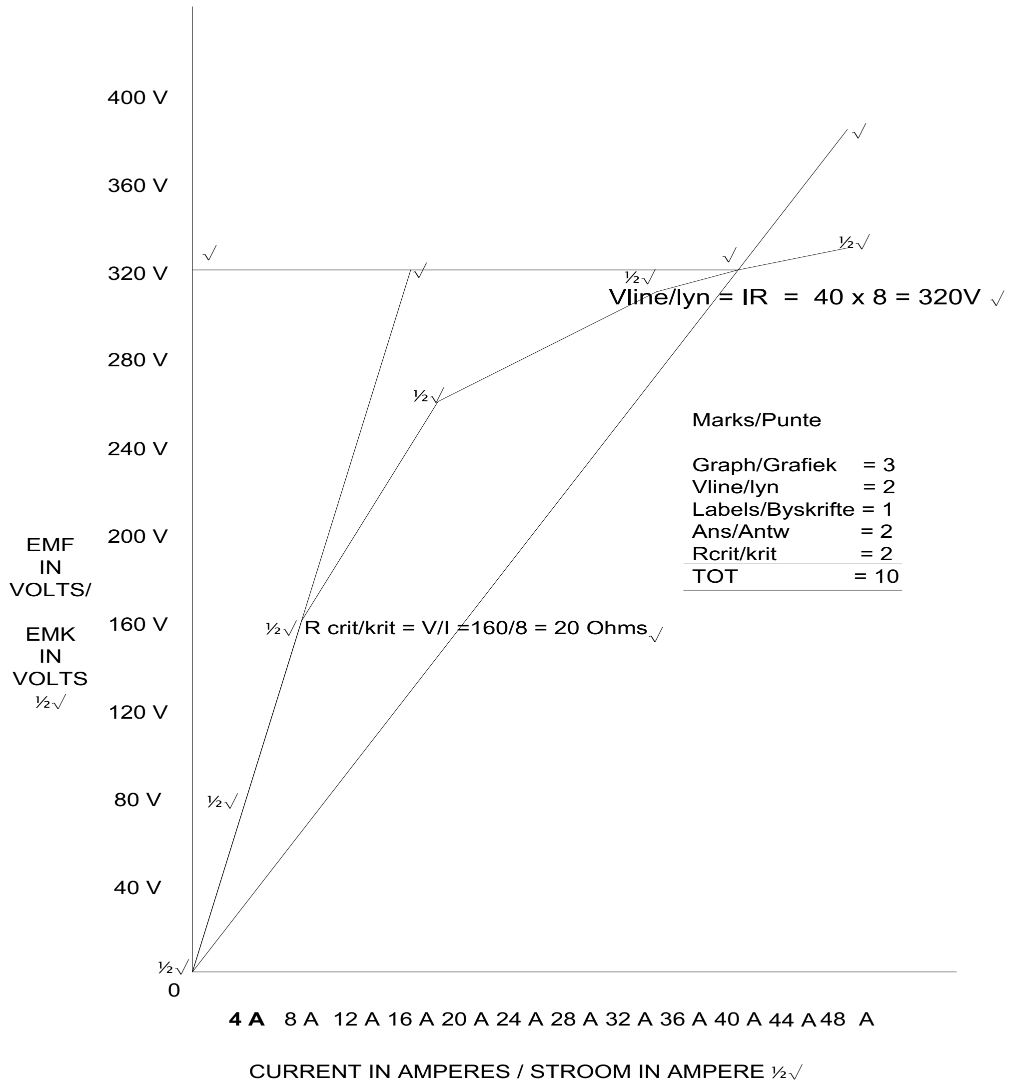
$\alpha = \mathbf{0,004\ per\ degree\ C}$

(3)

[20]

QUESTION 3

3.1



(10)

3.2 $I_{SH} = \frac{V + I_L R_{SE}}{R_{SH}}$

$= \frac{360 + (50x0,8)}{10}$ ✓✓ $I_a = I_L + I_{SH}$ $E = V + I_a R_a + I_L R_{SE}$

$= 50 + 40$ ✓ $= 360 + (90x0,2) + 50(0,8)$ ✓✓

$= \frac{400}{10}$ $= 90\ A$ $= 418\ V$

$= 40\ A$ (5)

3.3 Shunt connected
Series connected
Compound connected (3)

3.4 To limit the initial starting current to an acceptable value. (2)
[20]

QUESTION 4

4.1 $E_1 = 4{,}44\Phi_m f N_1$

$N_1 = E_1 / 4{,}44 f\,\Phi_m$
$= 888/4{,}44 \times 50 \times 1 \times 200 \times 10^{-4}$
$=$ <u>200 Windings</u>✓✓✓✓

$N_2 = \frac{V_2 x N_1}{V_1} = \frac{888\ 0x100}{444} = 2000$ Windings✓✓

$V_{rms} = 0{,}707\ V_m$

(6)

4.2 4.2.1 $V_m = 360/0{,}707 = 509{,}194\ V$✓

4.2.2 $T = \frac{1}{f}$

$T = \frac{1}{50} =$ <u>20 ms</u> ✓

(2 × 1) (2)

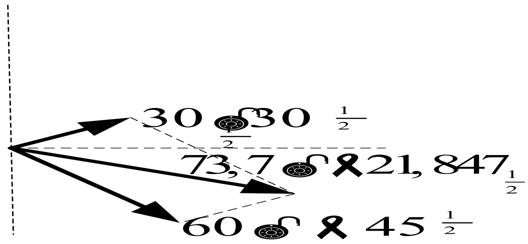
4.3 4.3.1 $i_1 = 60\angle -45^\circ = 42{,}42641 - j\,42{,}42641$

✓✓

$i_2 = 30\angle 30^\circ = 25{,}98076 + j\,15$

Total current $= 68{,}4072 - j\ 27{,}426$✓
$= 73{,}7\angle -21{,}8473^\circ$✓
$i_T = 73{,}7\ \text{Sin}(wt - 21{,}8473^\circ)A$ ✓ (5)

4.3.2



(2)

4.4 4.4.1 $\mathbf{Z_1 = 9 + j\,9 = 12{,}729\angle 45^\circ}$ $\mathbf{Z_2 = 3 - j\,3 = 4{,}2426\angle -45^\circ}$

$\mathbf{Z_T = 12 + j6}$ ✓

$\mathbf{Z_T = 13{,}416\angle 26{,}5651^\circ\Omega}$ ✓

V = I Z (3)

4.4.2 $\therefore\ \mathbf{I = \frac{V}{Z}}$

$= \dfrac{\mathbf{268{,}3282\angle 0^\circ}}{\mathbf{13{,}416\angle 26{,}5651^\circ}}$ = 20 $\angle$-26,5651° = 20 A✓✓

arbeidsfaktor = Cos -26,5651 lagging✓ (2)

= 0,894

[20]

QUESTION 5

5.1

$\mathbf{I_V = \frac{V}{R_V} = \frac{120}{600} = 0{,}2A}$ ✓

$\mathbf{I_A = \frac{V}{R_A} = \frac{120}{400} = 0{,}3\ A}$ ✓

$\mathbf{I_T = I_V + I_R = 0{,}2 + 0{,}3 = 0{,}5\ A}$ ✓

$\mathbf{V_X = V_T - V_R = 360 - 120 = 240\ A}$ ✓

$\mathbf{R_x = \frac{V_X}{I_X} = \frac{240}{0{,}5} = 480\ \Omega}$ ✓

(5)

5.2 It serves as a protection system and activates an alarm. (2)

5.3 It produces a constant torque and let the motor run quietly and ensures that it operates at a good power factor. (3)

5.4 Calcium chloride or silica gel which extracts the moisture from the air. (2)

5.5	5.5.1	Radial and ring feeders	(2)
	5.5.2	Radial feeders	(1)
5.6	5.6.1	$\frac{V_P}{V_S} = \frac{N_P}{N_S} \therefore V_S = \frac{V_P N_S}{N_P} = \frac{6\,000 x 300}{3\,000} = \underline{600\ V}$ ✓	(1)
	5.6.2	$S = VI \therefore I_S = \frac{S}{V} = \frac{30\,000}{6\,000} = \underline{5\ A}$ ✓	
		$S = VI \therefore I_P = \frac{S}{V} = \frac{30\,000}{600} = \underline{50\ A}$ ✓	(2)
	5.6.3	$E = 4{,}44 \Phi_M fN \therefore \Phi_M = \frac{6\,000}{4{,}44 \text{ x } 60 \text{ x } 3\,000} = 7{,}50571\ mWb$ ✓✓	(2)

[20]

TOTAL: 100