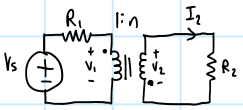
ASN3

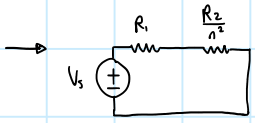
Monday, January 22, 2024 9:02 AM

1)



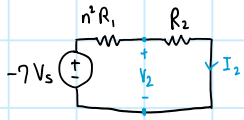
$V_s = 90\angle 0°$ V
$R_1 = 89\,\Omega$
$R_2 = 44\,\Omega$

a) Value of n for max power transfer:



$R_1 = \frac{R_2}{n^2} \rightarrow n = 0.7031$

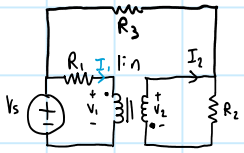
b) $n=7$; $V_2, I_2 = ?$



$I_2 = \frac{-7V_s}{n^2R_1 + R_2} = -0.1430$

$V_2 = \text{solve}\left(I_2 = \frac{-7V_s - V_2}{n^2 R_1}\right) = -6.2928$

c) $R_3 = 68\,\Omega$; $V_2, I_2 = ?$



eq1: $\frac{V_s - V_1}{R_1} = I_1$

eq2: $\frac{V_s - V_2}{R_3} + I_2 = \frac{V_2}{R_2}$

eq3: $\frac{V_2}{V_1} = -\frac{n}{1}$

eq4: $\frac{I_2}{I_1} = -\frac{1}{n}$

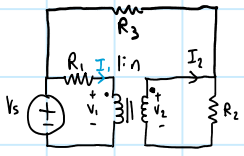
$V_1 = -4.4923$ V

$V_2 = 31.3062$ V

$I_1 = 1.0615$ A

$I_2 = -0.1516$ A

d) $V_2, I_2 = ?$



eq5: $\frac{V_2}{V_1} = \frac{n}{1}$

eq6: $\frac{I_2}{I_1} = \frac{1}{n}$

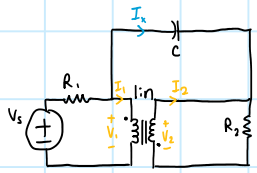
$V_1 = 5.5682$ V

$V_2 = 38.9776$ V

$I_1 = 0.9487$ A

$I_2 = 0.1355$ A

2)



$V_s(t) = 55\cos(4t) \rightarrow 55\angle 0°$

$R_1 = 30\Omega$

$R_2 = 70\Omega$

$C = 4mF \rightarrow \frac{1}{j\omega(0.004)}$

$n = 5$

$\omega = 4$

eq1: $\frac{V_1 - V_2}{C} = I_x$

eq2: $I_1 + I_x = \frac{V_s - V_1}{R_1}$

eq3: $I_2 + I_x = \frac{V_2}{R_2}$

eq4: $\frac{V_2}{V_1} = -\frac{n}{1}$

eq5: $\frac{I_2}{I_1} = -\frac{1}{n}$

$V_1 = 1.4783 - j\,2.1807$

$V_2 = -7.3916 + j\,10.9035$

$I_1 = 1.5747 - j\,6.9218\ E{-}2$

$I_2 = -0.3149 + j\,1.3846E{-}2$

$I_x = 0.2093 + j\,0.1419 = 0.25292\cos(4t + 0.59575)$

3)

$V_S = 35\angle 35°$

$R_1 = 6\ \Omega$

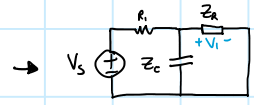
$R_2 = 9\Omega$

$Z_C = -j\,8\ \Omega$

$Z_L = j\,8\ \Omega$

$n = 2.22222$

$Z_T, V_1, -I_2 = ?$



$Z_R = \left(\frac{R_2 + Z_L}{(\frac{1}{n})^2}\right) = 44.4444 + j\,39.5061$

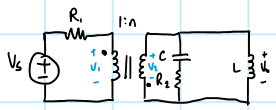
$Z_T = R_1 + RR(Z_C, Z_R) = 6.9584 - j\,8.6794 = 11.1243\angle -51.2804°$

$V_1 = \text{solve}\left(\frac{V_s - V_1}{R_1} = \frac{V_1}{Z_C} + \frac{V_1}{Z_R}\right) = 27.4457 + j\,1.2374 = 27.4735\angle 2.5815°$

$I_1 = \frac{V_1}{Z_R} = 0.3588 - j\,0.2911$

$-I_2 = -I_1 n = -(0.7973 - j\,0.6468) = 1.0267\angle 140.9480°$

4)



$V_s = 21\cos(300t)\,kV = 21000\cos(300t)$

$R_1 = 675\ \Omega$

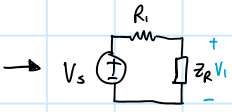
$R_2 = 870\Omega$

$C = 3\mu F = \frac{1}{j\omega(3E{-}6)}$

$L = 500mH = j\omega(0.5)$

$n = 5$

$V_0(t), S_s = ?$



$Z_R = \frac{RR(C + R_2, L)}{n^2} = 0.4624 + j\,6.5419$

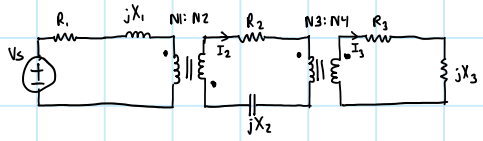
$I_1 = \frac{V_s - V_1}{R_1} = 31.0869 - j\,0.3011$

$V_1 = \text{solve}\left(I_1 = \frac{V_1}{Z_R}, V_1\right) = 16.3432 + j\,203.2292$

$V_0 = -nV_1 = -81.7160 - j\,1016.1462\ V = 1.0194\cos(300t - 1.6510)$ (abs(V_0), arg(V_0))

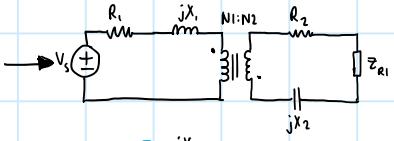
$S_s = \frac{1}{2}V_s \cdot I_1^* = 326.4277\angle 0.5549°\ kVA$

5)

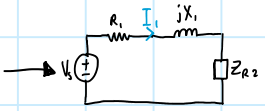


$V_s = 100\angle 0°$ V
$R_1 = 85\ \Omega$
$R_2 = 75\ \Omega$
$R_3 = 45\ \Omega$
$X_1 = 75\ \Omega$
$X_2 = -55\ \Omega$
$X_3 = 75\ \Omega$
$N_1 = 3$
$N_2 = 8$
$N_3 = 5$
$N_4 = 8$

$S_s, I_2, I_3 = ?$



$$Z_{R1} = \frac{R_2 + jX_3}{(N_4/N_3)^2} = 17.5781 + j\,29.7969$$



$$Z_{R2} = \frac{R_2 + Z_{R1} + jX_2}{(N_2/N_1)^2} = 13.0188 - j\,3.6145$$

$$I_1 = \frac{V_s}{R_1 + jX_1 + Z_{R2}} = 0.6666 - j\,0.4855$$

$$S_s = |V_s|I_1^* = 66.6632 + j\,48.5498 = 82.4686\angle 36.0657°$$

$$I_2 = -I_1\left(\frac{N_1}{N_2}\right) = -0.2500 + j\,0.1821 = 0.3093\angle 143.9348°$$

$$I_3 = I_2\left(\frac{N_3}{N_4}\right) = -0.1562 + j\,0.1138 = 0.1933\angle 143.9348°$$

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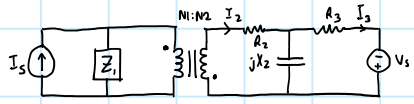
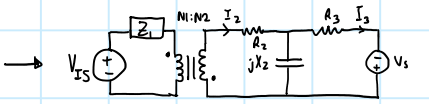
6)

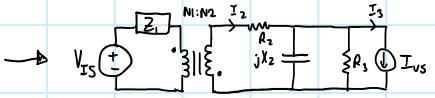


$I_s = 90\angle 30°$ A
$V_s = 90\angle 120°$ V
$Z_1 = 90 + j\,25\ \Omega$
$R_2 = 25\ \Omega$
$R_3 = 30\Omega$
$X_2 = -35\ \Omega$
$N_1 = 6$
$N_2 = 1$

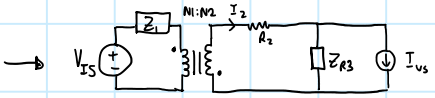
$S_{Z1}, I_2, I_3 = ?$



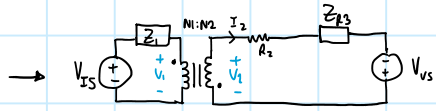
$V_{IS} = I_s \cdot Z_1 = 5889.8058 + j5998.8572$



$I_{VS} = \frac{V_s}{R_3} = 2.8191 - j1.0261$



$Z_{R3} = RR(jX_2, R_3) = 17.7941 - j14.8235$



$V_{VS} = I_{VS} \cdot Z_{R3} = 33.5436 - j59.5335$

eq1: $\frac{V_2 - V_{VS}}{R_2 + Z_{R3}} = \left(-\frac{N_1}{N_2}\right)$

eq2: $\frac{V_2}{V_1} = -\frac{N_2}{N_1}$

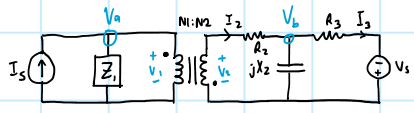
$V_1 = 5977.5796 + j5553.8987$

$V_2 = -962.9996 - j925.6464$

$I_1 = \frac{V_{IS} - V_1}{Z_1} = 2.4318 + j4.2654$

$S_{Z1} = V_1(I_s - I_1)^* = 662502.8611 + j184028.5725 = 687849.4901 \angle 15.5241°$

$I_1 = \frac{V_1}{Z_1} + I_s = 153.4578 + j85.7346$



$\rightarrow$ $V_1 = 5817.9313 + j5537.9130$
$V_2 = -969.6719 - j922.1522$
$I_1 = 2.6997 + j4.5967$
$I_2 = -12.4661 - j27.5801 = 30.2666 \angle -114.3998°$
$V_a = 5817.9313 + j5537.9130$
$V_b = -657.9690 - j232.6488$

① $\frac{V_2}{V_1} = -\frac{N_2}{N_1}$

② $\frac{I_2}{I_1} = -\frac{N_1}{N_2}$

③ $I_S = \frac{V_a}{Z_1} + I_1$

④ $V_a - V_1 = 0$

⑤ $I_2 = \frac{V_2 - V_b}{R_2}$

⑥ $I_2 = \frac{V_b}{jX_2} + \frac{V_b + V_s}{R_3}$

$I_3 = \frac{V_b + V_s}{R_3} = 21.0339 \angle -155.3749°$

$S_{Z1} = V_1 \cdot \text{conj}(i_s - i_1) = 664907.8636 + j184696.6788$
$= 690083.5541 \angle 15.5741°$

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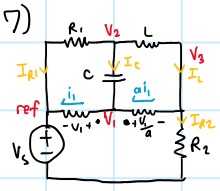
7)



$V_s = 7\cos(20t)\ kV = 7000 \angle 0°$
$w = 20$
$R_1 = 85\,\Omega$
$R_2 = 85\,\Omega$
$C = 3\,\mu F \rightarrow \frac{1}{jw3E\text{-}6}$
$L = 40mH \rightarrow jw\,40E\text{-}3$
$\alpha = 2$

$V_1(t)$, $i_1(t) = ?$

$I = \frac{V_2}{}$

$V_1(t)$, $i_1(t) = ?$

$I_{R1} = \frac{V_2}{R_1}$

$I_{R2} = \frac{V_3 - (-V_s)}{R_2}$

$I_C = \frac{V_2 - V_1}{C}$

$I_L = \frac{V_2 - V_3}{L}$

KCL 1: $\alpha i_1 + I_C = i_1$

KCL 2: $I_{R1} + I_C + I_L = 0$

KCL 3: $I_L = \alpha i_1 + I_{R2}$

eq 4: $V_3 + \frac{V_1}{\alpha} = V_1$

$i_1 = 2.4292\,E{-}3 - j0.2100 = 210.0569 \cos(2\pi t - 1.5592)$

$V_1 = -7000.6136 - j\,15.0885 = 7000.6298 \cos(2\pi t - 3.1394)$

$V_2 = -3499.8997 + j\,25.3979$

$V_3 = -3500.3068 - j\,7.5443$