11.6

باستفاده از مدل گره:

با فرض $V_n = 0$

$$I_n = -(I_A + I_B + I_C)$$

$$I_A = \frac{240e^{j0} - V_N}{60 + j80} \quad , \quad I_B = \frac{240e^{j120} - V_N}{40 + j30} \quad , \quad I_C = \frac{240e^{-j120} - V_N}{20 + j15} \quad , \quad I_n = \frac{V_N}{10}$$

$$I_A = \frac{240e^{j0} - V_N}{100e^{j53,1}} \quad , \quad I_B = \frac{240e^{j120} - V_N}{50e^{j36,8}} \quad , \quad I_C = \frac{240e^{-j120} - V_N}{25e^{j36,8}}$$

$$\rightarrow V_N(0,154 - j0,0439) = -6,31 - j0,934 \rightarrow V_N = -42,9e^{j23,7°}$$

$$I_n = -4,29e^{j23,7°} A$$

11.17

انتقال Y-Y

$$I_a = \frac{V_a}{1 + j5 + 25 + j25} = \frac{V_a}{26 + j30} = \frac{V_a}{39,7e^{j49°}}$$

$$V_{ab} = V_a - V_b = V_a(1 - e^{j120}) = V_a(1 + \tfrac{1}{2} - \tfrac{\sqrt{3}}{2}) = V_a \times \sqrt{3}e^{-j30°} = 208e^{j0}$$

$$\rightarrow V_a = 120e^{j30°} \rightarrow I_a = 3e^{-j19°} \quad , \quad I_b = 3e^{j101°} \quad , \quad I_c = 3e^{-j139°}$$

11.37

منبع Y، بار Δ

$20mH \mid \dfrac{}{60Hz} \rightarrow X = 7,53$ اهم

$$V_a = 120\underline{/30°} \rightarrow V_{ab} = \sqrt{3} \times 120 e^{j30} \cdot e^{-j30} = 208e^{j0}$$

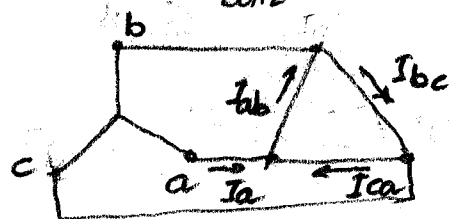$$I_{ab} = \frac{V_{ab}}{20 + j7,53} = \frac{208e^{j0}}{21,37e^{j20,6°}} = 9,73e^{-j20,6°}$$

$$I_a = I_{ab} - I_{ca} = I_{ab}(1 - e^{-j120}) = I_{ab}(\tfrac{3}{2} + j\tfrac{\sqrt{3}}{2})$$

$$I_a = \sqrt{3} I_{ab} e^{j30°} = 16,8e^{j9,4°}$$

$$I_b = I_a e^{j120°} \quad , \quad I_c = I_a e^{-j120°}$$

11.38

منبع Δ، بار Y

$V_n = 0 \ , \ V_N = 0$

$$V_{ab} = 208e^{j10°} \quad , \quad Z_\ell = 0,2 + j0,4 \ , \ Z_L = 3 + j2$$

$$V_{ab} = \sqrt{3} V_{an} e^{-j30°} \rightarrow V_{an} = \frac{V_{ab}}{\sqrt{3}} e^{j30°} = 120e^{j40°}$$

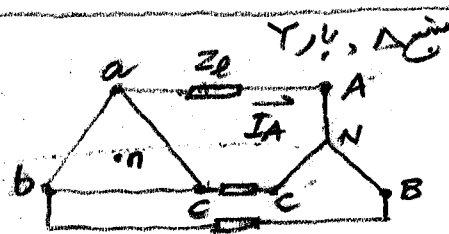$$I_A = \frac{V_{an}}{Z_\ell + Z_L} = \frac{120e^{j40°}}{3,2 + j2,4} = \frac{120e^{j40°}}{4e^{j36,8°}} = 30e^{j3,2°}$$

$$V_{AN} = V_{an} - Z_\ell I_A = 120e^{j40°} - (0,2 + j0,4) \times 30e^{j3,2°}$$

$$= 91,9 + j77,1 - 0,447e^{j63,4°} \times 30e^{j3,2°}$$

$$= 91,9 + j77,1 - 13,4e^{j66,6°} = 91,9 + j77,1 - (5,32 + j12,3)$$

$$V_{AN} = 86,5 + j64,8 = 116,2e^{j36,8°} \rightarrow V_{AB} = V_{AN} \times \sqrt{3} e^{-j30°} = 201e^{j6,8°}$$ ولت

ولتاژ خط در طرف بار

11.47

$I_{AB} = 15 e^{j40°}$, $Z_\ell = 0.3 + j0.2$, $Z_L = 9 + j6$

$I_{BC} = I_{AB} e^{j120°}$, $I_{CA} = I_{AB} e^{-j120°}$

نوع اتصال $I_A = I_{AB} \times \sqrt{3} e^{j30°} = 26 e^{j70°}$ آمپر
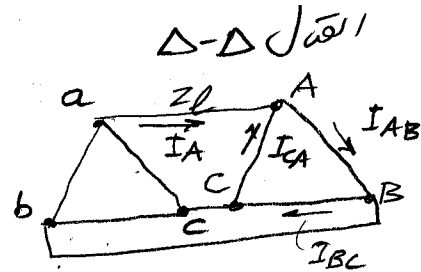
$V_{an} = V_{AN} + Z_\ell \times I_A = V_{AB} \times \frac{1}{\sqrt{3}} e^{j30°} + Z_\ell I_A$

$V_{an} = I_{AB} Z_L \times \frac{1}{\sqrt{3}} e^{j30°} + Z_\ell \times I_{AB} \times \sqrt{3} e^{j30°} = I_{AB} \times e^{j30°} \left(\frac{Z_L}{\sqrt{3}} + \sqrt{3} Z_\ell \right)$

در نتیجه $V_{an} = 15 e^{j40°} \times e^{j30°} \left(\frac{9+j6}{\sqrt{3}} + \sqrt{3} \times 0.3 + j\sqrt{3} \times 0.2 \right) = 15 e^{j70°} \times (5.71 + j3.81) = 103 e^{j103.7°}$
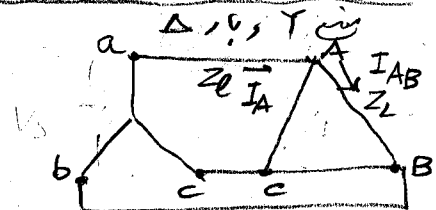
$V_{bn} = V_{an} e^{j120°}$, $V_{cn} = V_{an} e^{-j120°}$

11.62

$I_{AB} = 10 \angle -30°$ آمپر

$V_{AB} = \frac{12000}{3 \times 10} \angle 45.5° - 30° = 400 \angle 15.5°$ ولت

$\rightarrow Z_L = \frac{400 \angle 15.5°}{10 \angle -38°} = 40 \angle 45.5°$ اهم

$14000 \angle \cos^{-1} 0.75 - 12000 \angle \cos^{-1} 0.7 = |I_A|^2 Z_\ell \times 3$

$10500 + j9260 - 8400 - j8570 = 2100 + j690 = (10\sqrt{3})^2 Z_\ell \times 3 \rightarrow Z_\ell = 2.3 + j0.76$

11.67

$I_L = \frac{400 \times 10^3}{3 \times 13.8 \times 10^3} e^{-j \cos^{-1} 0.9} + \frac{200 \times 10^3}{3 \times 13.8 \times 10^3} e^{-j \cos^{-1} 0.85} + \frac{100 \times 10^3}{3 \times 13.8 \times 10^3} e^{-j \cos^{-1} 0.9}$

$I_L = 8.69 - j4.21 + 4.1 - j2.54 + 2.17 - j1.05 = 14.96 - j7.8 = 16.87 e^{-j27.5°}$ آمپر

مقدار جریان خط

11.77

بار $S = 8 \times 10^6 e^{j \cos^{-1} 0.8} = 6.4 + j4.8$ MVA

با خازن $S' = S + 3 \times (-j\omega c |V_P|^2)$

$PF = 0.9 \rightarrow \cos\left(\tan^{-1} \frac{Q}{P} \right) = 0.9 \rightarrow Q = 3.1$ MVAR

خازن $Q = -1.7$ MVAR $= 3 \left[-2\pi \times 60 \times C \times \left(\frac{4800}{\sqrt{3}} \right)^2 \right]$

$\rightarrow C = 196 \mu F$