12.39 Find the real power absorbed by the load in Fig. 12.58.

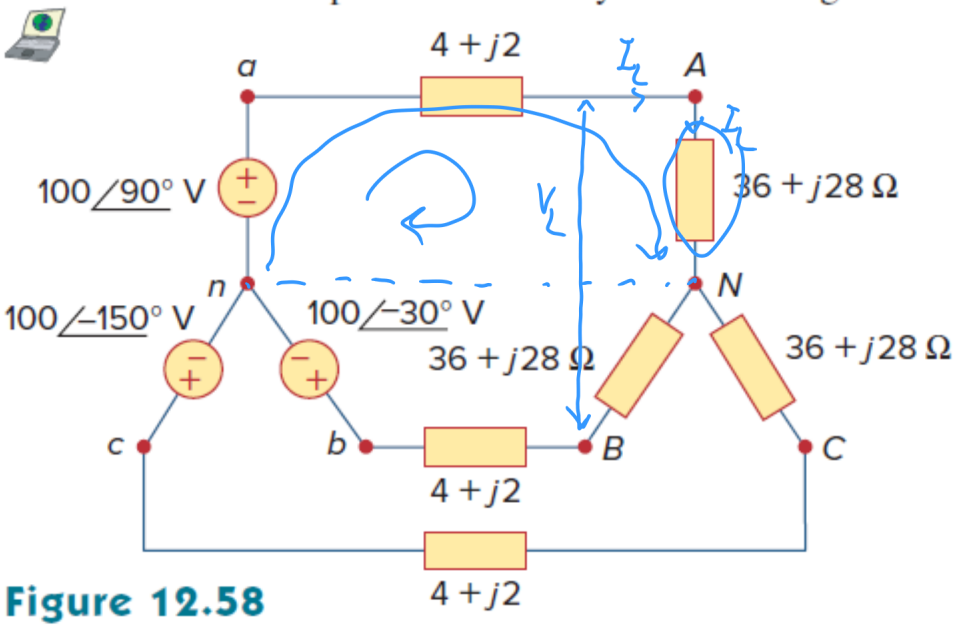


Figure 12.58
For Prob. 12.39.

$P = \sqrt{3}\, V_L\, I_L \cos\theta$ → yükün güç faktörü
→ hat akımının büyüklüğü
→ hat gerilimnn büyüklüğü

bunun yerine

$$P = 3 \times \frac{1}{2} |\bar{I}_L|^2 36$$

$$\bar{I}_L = \bar{I}_{aA} = \frac{100\angle 90^\circ}{4+j2+36+j28} = \frac{100\angle 90^\circ}{40+j30} = \frac{100\angle 90^\circ}{50\angle 37^\circ} = 2\angle 53^\circ \text{ A}$$

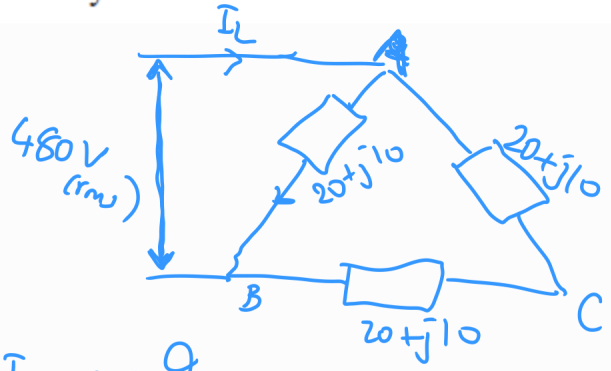
$$P = \frac{3}{2} \times 4 \times 36 = 216 \text{ W}$$

12.49 Each phase load consists of a 20-Ω resistor and a 10-Ω inductive reactance. With a line voltage of 480 V rms, calculate the average power taken by the load if:

(a) the three-phase loads are delta-connected
(b) the loads are wye-connected

$j10\,\Omega$

a)



$$\sqrt{3}\,V_L\,I_L\cos\theta$$

$V_L = 480$

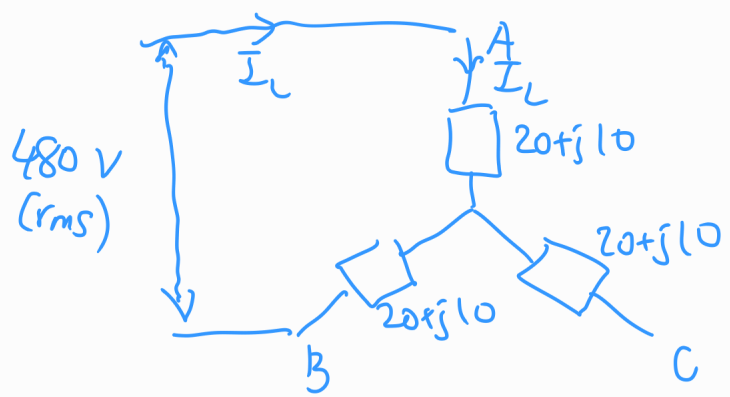
$$I_{AB} = \frac{480}{|20+j10|} = \frac{480}{10\sqrt{5}} \rightarrow \text{faz akımı büyüklüğü}$$

$$I_L = \sqrt{3}\,\frac{480}{10\sqrt{5}}$$

$$\cos\theta = \frac{20}{|20+j10|} = \frac{20}{10\sqrt{5}} = \frac{2}{\sqrt{5}}$$

$$P = \sqrt{3}\times 480\times\frac{\sqrt{3}\,480}{10\sqrt{5}}\times\frac{2}{\sqrt{5}} = 6\times\frac{480^2}{50} = 27.648\,\text{kW}$$

b)

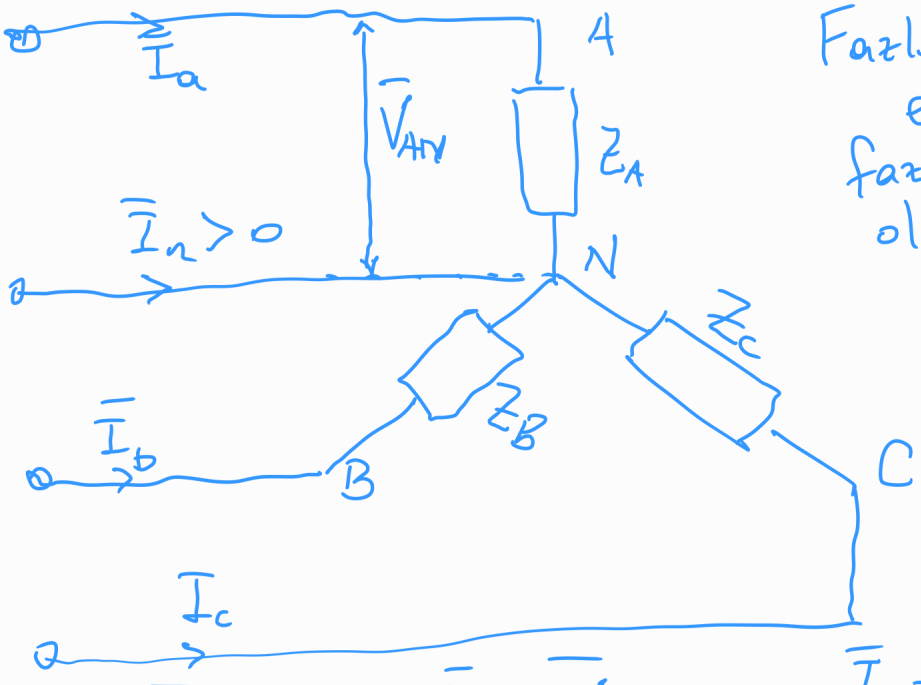


$$I_L = \frac{480}{\sqrt{3}}\,\frac{1}{|20+j10|} = \frac{480}{\sqrt{3}\,10\sqrt{5}}$$

$$P = \sqrt{3}\, V_L\, I_L \cos\theta = \sqrt{3}\ \underbrace{480}_{V_L}\ \underbrace{\frac{480}{\sqrt{3}\,10\sqrt{5}}}_{I_L}\ \underbrace{\frac{2}{\sqrt{5}}}_{\cos\theta}$$

$$= \frac{2\times 480^2}{50} = 9.216\ kW //$$

12.8 Dengesiz üç Fazlı Sistem



Fazlardaki yükler eşit olmazsa üç fazlı sistem dengesiz olarak adlandırılır.

$$\bar{I}_a = \frac{\bar{V}_{AN}}{Z_A} \qquad \bar{I}_b = \frac{\bar{V}_{BN}}{Z_B} \qquad \bar{I}_c = \frac{\bar{V}_{CN}}{Z_C}$$

$$\bar{I}_n = -(\bar{I}_a + \bar{I}_b + \bar{I}_c)$$

Nötr bağlantısı yoksa çevre akım yöntemi kullanarak analiz edebilirsiniz.

Benzer analizler Y-Δ, Δ-Y ve Δ-Δ için de yapılabilir.

Güç hesabı yaparken bütün fazlar için ayrı ayrı yapmak gerekir. Çünkü fazlar simetrik değil.

Practice Problem 12.9

The unbalanced Δ-load of Fig. 12.24 is supplied by balanced line-to-line voltages of 440 V in the positive sequence. Find the line currents. Take $\mathbf{V}_{ab}$ as reference.

Answer: $39.71\angle -41.06^\circ$ A, $64.12\angle -139.8^\circ$ A, $70.13\angle 74.27^\circ$ A.

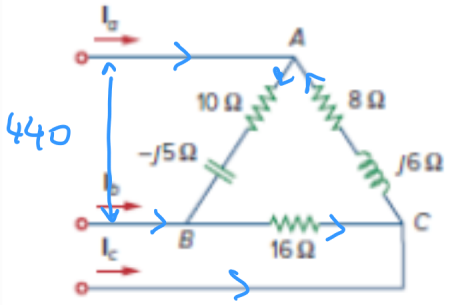


Figure 12.24
Unbalanced Δ-load; for Practice Prob. 12.9.

$\bar{V}_{AB} = 440\angle 0^\circ \quad \bar{V}_{BC} = 440\angle -120^\circ \quad \bar{V}_{CA} = 440\angle +120^\circ$

Line current $\bar{I}_a, \bar{I}_b, \bar{I}_c$?

FAZ $\bar{I}_{AB} = \dfrac{440\angle 0^\circ}{10+j5}$ $\quad \bar{I}_{BC} = \dfrac{440\angle -120^\circ}{16}$ $\quad \bar{I}_{CA} = \dfrac{440\angle +120^\circ}{8+j6}$

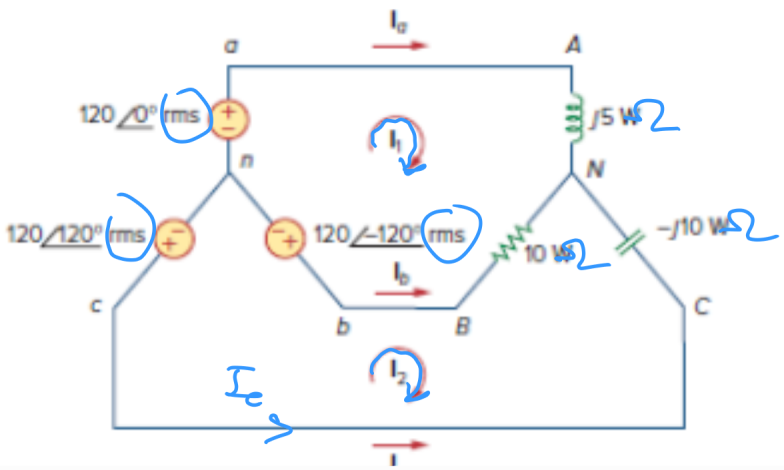
ATKIMLARI

Sonrada:

$$\bar{I}_a = \bar{I}_{AB} - \bar{I}_{CA}$$
$$\bar{I}_b = \bar{I}_{BC} - \bar{I}_{AB}$$
$$\bar{I}_c = \bar{I}_{CA} - \bar{I}_{BC}$$

Example 12.10

For the unbalanced circuit in Fig. 12.25, find: (a) the line currents, (b) the total complex power absorbed by the load, and (c) the total complex power absorbed by the source.



a) $\bar{I}_a, \bar{I}_b, \bar{I}_c$?

b) $\bar{S}_A + \bar{S}_B + \bar{S}_C$?

c) $\bar{S}_a + \bar{S}_b + \bar{S}_c$?

(1) $-120\angle 0^\circ + j5 I_1 + 10(I_1 - I_2) + 120\angle -120^\circ = 0$

(2) $120\angle 120^\circ - 120\angle -120^\circ + 10(I_2 - I_1) - j10 I_2 = 0$

(1) $I_1(10+j5) - 10I_2 = +120 - 120\angle -120^\circ$

(2) $-10I_1 + (10-j10)I_2 = 120\angle -120^\circ - 120\angle 120^\circ$

$$\underbrace{\begin{bmatrix} 10+j5 & -10 \\ -10 & 10-j10 \end{bmatrix}}_{A} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 120 - 120\angle -120^\circ \\ 120\angle -120^\circ - 120\angle 120^\circ \end{bmatrix} \simeq \underbrace{\begin{bmatrix} 180 + j104 \\ -j208 \end{bmatrix}}_{b}$$

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = A^{-1} \cdot b = \begin{bmatrix} 56.8 \\ 38.8 + j18 \end{bmatrix} \rightarrow \text{Çevre akımları}$$

$I_a = I_1 = 56.8$

$I_b = I_2 - I_1 = -18 + j18$

$I_c = -I_2 = -38.8 - j18$ ✓

b) $\bar{S}_A = |I_a|^2 j5 = j16122$

$\bar{S}_B = |I_b|^2 10 = 6480$

$\bar{S}_C = |I_c|^2 (-j10) = -j18282$

$+$

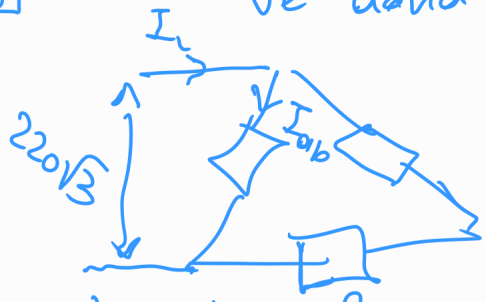
$\bar{S} = \underbrace{6480}_{P} + j\underbrace{2160}_{Q}$

c) Kaynak $\bar{S}_s = -6480 - j2160$ olur.

Notlar:

- Y kaynak : elektrik iletiminde daha avantajlı
  Çünkü daha yüksek hat gerilimi:
  $(220\sqrt{3}) \rightarrow 380V_{rms}$.
  ve daha düşük akım. (Δ yük için.)

Y-Δ



$$I_{ab} = \frac{I_L}{\sqrt{3}}$$

- Evlerde tek faza döner, endüstride üç faz.

12.10 Uygulamalar.

12.10.2 Meskenlerde Kablolama

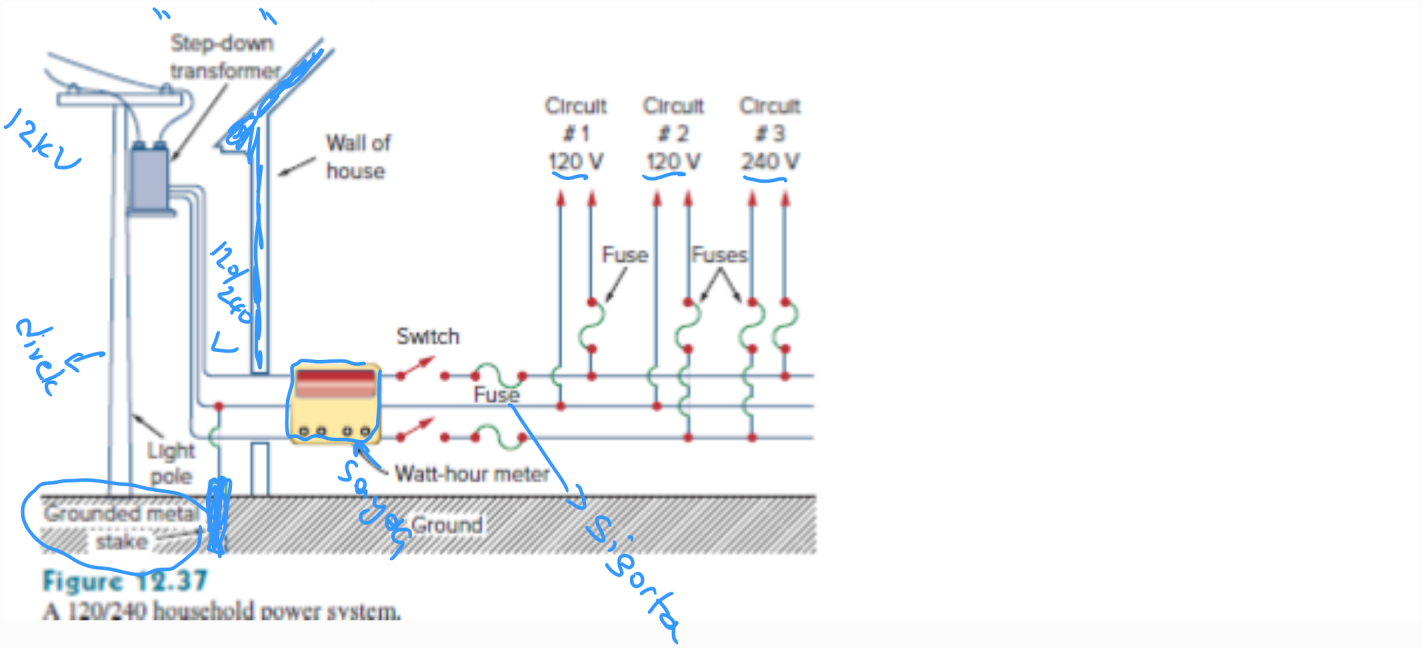


Figure 12.37
A 120/240 household power system.

- ABD'de 120 V 60 Hz, TR'de 220V 50Hz.
- Çoğu elektrikli ev aleti tek faz olarak çalışır.
- Evlere elektrik 3 tel AC sistemi ile gelir.
  Kırmızı, siyah, beyaz kablo
- Günümüzde yeni evlere üç faz ve nötr gelmekte ve ev aletleri bu üç faza dağıtılmaktadır.
- Bütün cihazlar paralel bağlı.

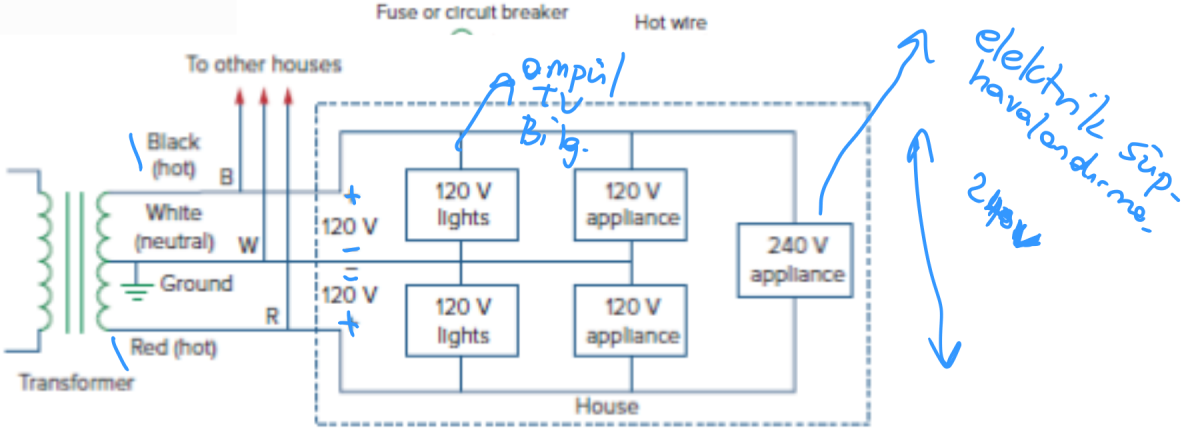


Figure 12.38
Single-phase three-wire residential wiring.

- Tehlikeyi azaltmak için yalıtım, topraklama, sigortalar ve devre kesiciler kullanılır.
- Toprak hattı nötr gibi akım taşımaz, ancak can güvenliği sağlar.

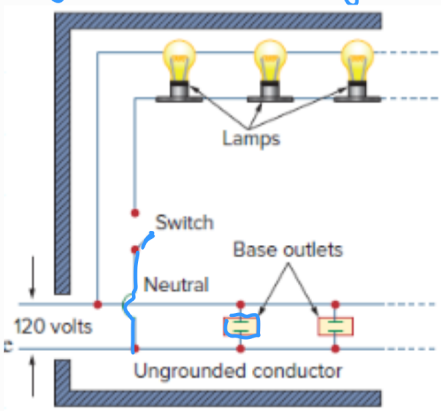


Figure 12.39
A typical wiring diagram of a room.
Source: A. Marcus and C. M. Thomson, *Electricity for Technicians*, 2nd edition, © 1975, p. 325. Pearson Education, Inc., Upper Saddle River, NJ.

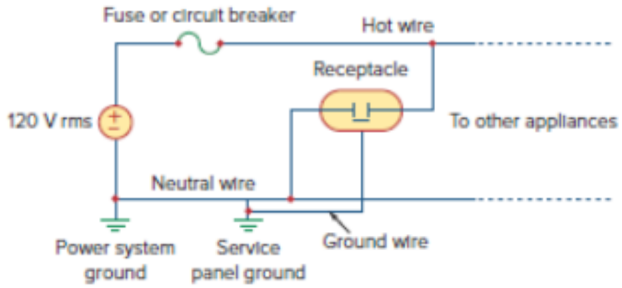


Figure 12.40
Connection of a receptacle to the hot line and to the ground.

- Topraklama özellikle yıldırım düştüğünde güvence sağlar, elektrik şokunu minimize eder.
- İnsan direnci, kişiye, vücudun ıslak kuru olmasına göre değişir.
- $< 1mA$ akımlar pek tehlikeli olmaz.
  $> 10mA$ akımlar şok yaratır.