

7.2 EFFEKT TYPER OG ARBEID I VEKSELSTRØM

7.2.1

$$P = \frac{U^2}{R} = \frac{235V^2}{100} = \underline{\underline{552,3W}}$$

7.2.2

$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50\text{Hz} \cdot 314 \cdot 10^{-3}\text{H} = \underline{\underline{98,65\Omega}}$$

$$Q_L = \frac{U^2}{X_L} = \frac{200V^2}{98,65\Omega} = \underline{\underline{405,5\text{VAR}}}$$

7.2.3

$$X_C = \frac{1}{2 \cdot \pi \cdot f \cdot C} = \frac{1}{2 \cdot \pi \cdot 50\text{Hz} \cdot 62,8 \cdot 10^{-6}\text{F}} = \underline{\underline{50,7\Omega}}$$

$$Q_C = \frac{U^2}{X_C} = \frac{400V^2}{50,7\Omega} = \underline{\underline{3155,8\text{VAR}}}$$

7.2.4

$$a) X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50\text{Hz} \cdot 32,2 \cdot 10^{-3}\text{H} = \underline{\underline{10,1\Omega}}$$

$$\bar{Z} = R + jX_L = 2\Omega + j10,1\Omega = \underline{\underline{10,3\Omega}} \quad \angle \varphi = \underline{\underline{78,8^\circ}}$$

$$b) I = \frac{U}{Z} = \frac{230V}{10,3\Omega} = \underline{\underline{22,3A}}$$

$$c) S = U \cdot I = 230V \cdot 22,3A = \underline{\underline{5130\text{VA}}}$$

$$P = U \cdot I \cdot \cos \varphi = 230V \cdot 22,3A \cdot \cos 78,8^\circ = \underline{\underline{996,4W}}$$

$$Q_L = U \cdot I \cdot \sin \varphi = 230V \cdot 22,3A \cdot \sin 78,8^\circ = \underline{\underline{5032,4\text{VAR}}}$$

$$d) W = P \cdot t = 996,4W \cdot 60s = \underline{\underline{59784\text{J}}} = \underline{\underline{59,78\text{kJ}}}$$

7.2.5

$$X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 50 \text{ Hz} \cdot 191,0 \cdot 10^{-3} \text{ H} = \underline{60,0 \Omega}$$

$$\bar{Z} = R + jX_L = 10 \Omega + j60,0 \Omega = \underline{60,8 \Omega} \quad \angle \varphi = \underline{80,5^\circ}$$

$$I = \frac{U}{Z} = \frac{400 \text{ V}}{60,8 \Omega} = \underline{6,58 \text{ A}}$$

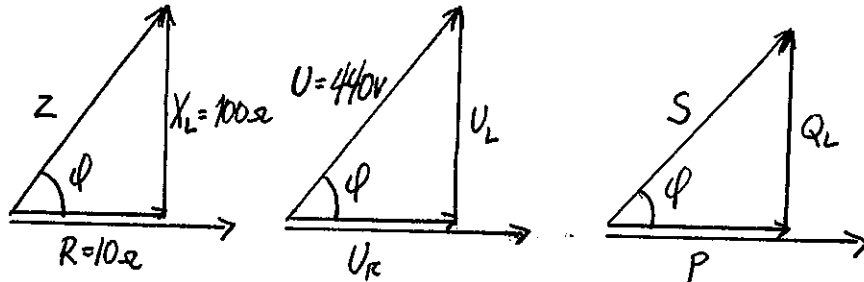
$$S = U \cdot I = 400 \text{ V} \cdot 6,58 \text{ A} = \underline{2630,4 \text{ VA}}$$

$$P = U \cdot I \cdot \cos \varphi = 400 \text{ V} \cdot 6,58 \text{ A} \cdot \cos 80,5^\circ = \underline{434,1 \text{ W}}$$

$$Q_L = U \cdot I \cdot \sin \varphi = 400 \text{ V} \cdot 6,58 \text{ A} \cdot \sin 80,5^\circ = \underline{2594,3 \text{ VAR}}$$

7.2.6

$$a) X_L = 2 \cdot \pi \cdot f \cdot L = 2 \cdot \pi \cdot 60 \text{ Hz} \cdot 265,3 \cdot 10^{-3} \text{ H} = \underline{100,0 \Omega}$$



$$\bar{Z} = R + jX_L = 10 \Omega + j100 \Omega = \underline{100,5 \Omega} \quad \angle \varphi = \underline{84,3^\circ}$$

$$b) I = \frac{U}{Z} = \frac{440 \text{ V}}{100,5 \Omega} = \underline{4,38 \text{ A}}$$

$$c) \begin{cases} U_R = U \cdot \cos \varphi = 440 \text{ V} \cdot \cos 84,3^\circ = \underline{43,7 \text{ V}} \\ U_L = U \cdot \sin \varphi = 440 \text{ V} \cdot \sin 84,3^\circ = \underline{437,8 \text{ V}} \end{cases}$$

$$d) \bar{U} = U \angle \varphi = 440 \text{ V} \angle 84,3^\circ = \underline{43,7 \text{ V} + j 437,8 \text{ V}}$$

$$e) S = U \cdot I = 440 \text{ V} \cdot 4,38 \text{ A} = \underline{1927,2 \text{ VA}}$$

$$\bar{S} = S \angle \varphi = 1927,2 \text{ VA} \angle 84,3^\circ = \underline{191,4 \text{ W} + j 1917,7 \text{ VAR}}$$

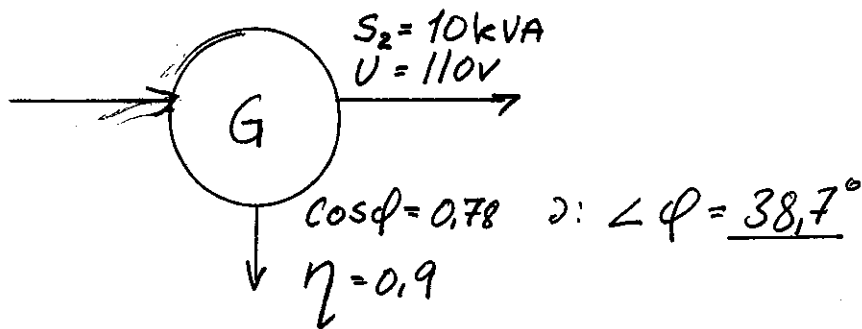
7.2.8:

$$P = \frac{U_R^2}{R} \Rightarrow U_R = \sqrt{P \cdot R} = \sqrt{6250 \text{ W} \cdot 10 \Omega} = \underline{\underline{250 \text{ V}}}$$

7.2.9

$$\vec{S} = P + jQ_L = 200 \text{ W} + j2800 \text{ VAR} = \underline{\underline{2807,1 \text{ VA}}} \quad \angle \varphi = \underline{\underline{85,9^\circ}}$$

7.2.10



$$a) \quad S = U \cdot I \Rightarrow I = \frac{S}{U} = \frac{10 \cdot 10^3 \text{ VA}}{110 \text{ V}} = \underline{\underline{90,9 \text{ A}}}$$

$$b) \quad P = S \cdot \cos \varphi = 10 \cdot 10^3 \text{ VA} \cdot 0,78 = \underline{\underline{7800 \text{ W}}} = \underline{\underline{7,8 \text{ kW}}}$$

$$Q = \sqrt{S^2 - P^2} = \sqrt{10 \cdot 10^3 \text{ VA}^2 - 7,8 \cdot 10^3 \text{ W}^2} = \underline{\underline{6257,8 \text{ VAR}}}$$

$$c) \quad \vec{U} = U \angle \varphi = 110 \text{ V} \angle 38,7^\circ = \underline{\underline{85,8 \text{ V} + j68,8 \text{ V}}}$$

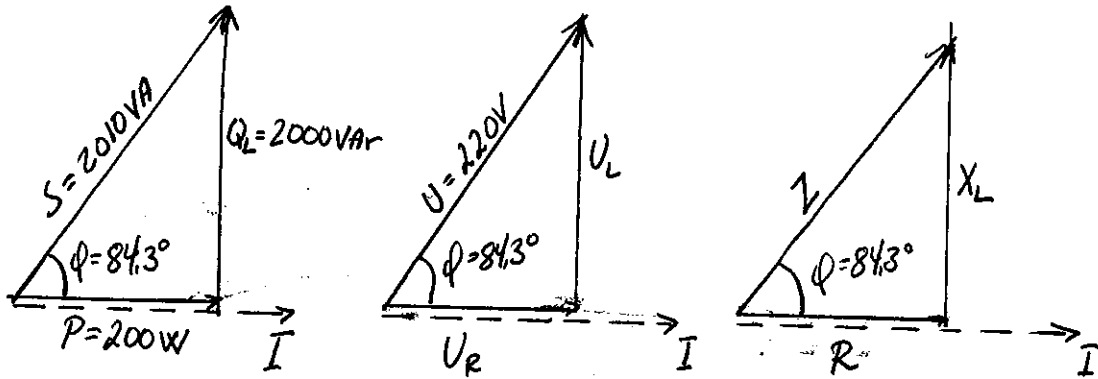
$$d) \quad Z = \frac{U}{I} = \frac{110 \text{ V}}{90,9 \text{ A}} = \underline{\underline{1,21 \Omega}}$$

$$\vec{Z} = Z \angle \varphi = 1,21 \Omega \angle 38,7^\circ = \underline{\underline{0,94 \Omega + j0,76 \Omega}}$$

$$e) \quad \eta = \frac{P_{\text{avg}}}{P_{\text{eff}}} \Rightarrow P_{\text{eff}} = \frac{P_{\text{avg}}}{\eta} = \frac{7800 \text{ W}}{0,9} = \underline{\underline{8667 \text{ W}}}$$

7.2.11

$$\bar{S} = P + jQ_L = 200W + j2000VAR = \underline{2010,0VA} \quad \angle \varphi = \underline{84,3^\circ}$$



$$S = U \cdot I \Rightarrow I = \frac{S}{U} = \frac{2010VA}{220V} = \underline{9,14A}$$

$$Z = \frac{U}{I} = \frac{220V}{9,14A} = \underline{24,08\Omega}$$

$$\bar{Z} = Z \angle \varphi = 24,08\Omega \angle 84,3^\circ = \underline{2,39\Omega + j23,96\Omega}$$

$$X_L = 2 \cdot \pi \cdot f \cdot L \Rightarrow f = \frac{X_L}{2 \cdot \pi \cdot L} = \frac{23,96\Omega}{2 \cdot \pi \cdot 300 \cdot 10^{-3}H} = \underline{\underline{12,7Hz}}$$

7.2.12

a) $\varphi = \frac{\pi}{3}$ i radianer

$$\frac{\varphi}{360^\circ} = \frac{\pi}{3} \Rightarrow \varphi = \frac{\pi}{3} \cdot \frac{360^\circ}{2\pi} = \underline{\underline{60^\circ}}$$

b) $U = \frac{U_m}{\sqrt{2}} = \frac{311,13V}{\sqrt{2}} = \underline{220V} \quad I = \frac{I_m}{\sqrt{2}} = \frac{21,21A}{\sqrt{2}} = \underline{15A}$

$$Z = \frac{U}{I} = \frac{220V}{15A} = \underline{\underline{14,67\Omega}}$$

$$\bar{Z} = Z \angle \varphi = 14,67\Omega \angle 60^\circ = \underline{\underline{7,33\Omega + j12,7\Omega}}$$

c) $\bar{U} = U \angle \varphi = 220V \angle 60^\circ = \underline{\underline{110V + j190,5V}}$

$$d) S = U \cdot I = 220 \text{ V} \cdot 15 \text{ A} = \underline{\underline{3300 \text{ VA}}}$$

$$\bar{S} = S \angle \varphi = 3300 \text{ VA} \angle 60^\circ = \underline{\underline{1650 \text{ W} + j 2858 \text{ VAR}}}$$

$$e) u = 311,13 \text{ V} \cdot \sin\left(2 \cdot \pi \cdot 50 \text{ Hz} \cdot 2,5 \cdot 10^{-3} \text{ s} + \frac{\pi}{3}\right) = \underline{\underline{300,5 \text{ V}}}$$

$$i = 21,21 \text{ A} \cdot \sin\left(2 \cdot \pi \cdot 50 \text{ Hz} \cdot 2,5 \cdot 10^{-3} \text{ s}\right) = \underline{\underline{15 \text{ A}}}$$

7.2.13

Mellom induktiv reaktans og kapasitiv reaktans er det 180°

7.2.14

$$a) \bar{S} = S \angle \varphi = 3,0 \cdot 10^3 \text{ VA} \angle 78,5^\circ = \underline{\underline{598,1 \text{ W} + j 2940 \text{ VAR}}}$$

$$b) \cos \varphi = \underline{\underline{0,199}}$$

$$c) S = U \cdot I \Rightarrow I = \frac{S}{U} = \frac{3000 \text{ VA}}{230 \text{ V}} = \underline{\underline{13,04 \text{ A}}}$$

$$d) Z = \frac{U}{I} = \frac{230 \text{ V}}{13,04 \text{ A}} = \underline{\underline{17,6 \Omega}}$$

$$\bar{Z} = Z \angle \varphi = 17,6 \Omega \angle 78,5^\circ = \underline{\underline{3,52 \Omega + j 17,3 \Omega}}$$