

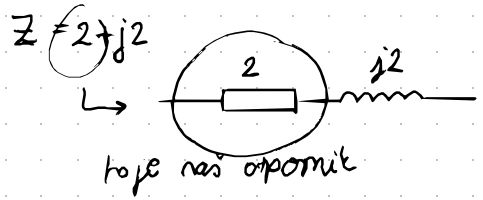
## 7. SNAGA IZMJENIČNE STRUJE

$$P = \frac{U^2}{R} \quad \text{ili} \quad P = I^2 \cdot R \quad P = U \cdot I$$

### RADNA SNAGA (P) [W]

- samo na otpornicima
- R, uvijek realan dio gledamo

$$\Rightarrow P = I^2 \cdot \operatorname{Re}\{Z\} \quad P = \frac{U^2}{\operatorname{Re}\{Z\}}$$

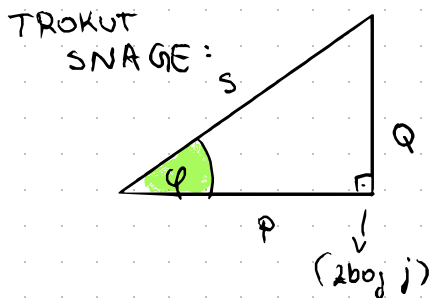


### JALOVA SNAGA (Q)

- zavojnice
- kondenzatori

$$\left. \begin{array}{l} P = I^2 \cdot \operatorname{Im}\{Z\} = I^2 \cdot X \\ P = \frac{U^2}{\operatorname{Im}\{Z\}} = \frac{U^2}{X} \end{array} \right\} \quad [\text{Var}]$$

### PRIVIDNA SNAGA (S) $S = U \cdot I$ [VA]



$$S^2 = P^2 + Q^2$$

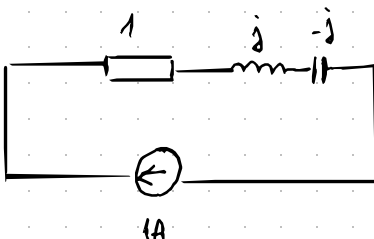
$\cos \varphi = \text{FAKTOR SNAGE}$

$Q_L$  i  $Q_C$  su suprotnih smjerova (oduzimamo ih)

$Q_{uk} = |Q_L - Q_C| \rightarrow$  koja od njih je veća - snaga je te prirode

$\hookrightarrow$  INDUKTIVNA ili KAPACITIVNA

Primjer:



$$P = I^2 \cdot \operatorname{Re}(Z) = 1 \text{ W}$$

$$Q_L = I^2 \cdot \operatorname{Im}(Z) = 1 \text{ Var}$$

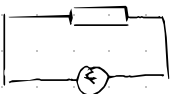
zavojnica

$$Q_C = I^2 \cdot \operatorname{Im}(X_C) = -1 \text{ Var}$$

$$Q_{uk} = 2 \text{ Var} \quad \text{— ali to je besno}$$

$\hookrightarrow$  jer se  $X_L$  i  $X_C$  ponište

0 Var

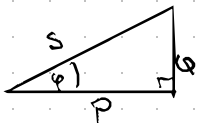


## JESEN 19./20.

① Serijski spoj  $R=5\Omega$  ;  $X_C=15\Omega$

$$U_R=31,623V$$

$$S=?$$



$P=\frac{U^2}{R}=200W$  ali lakše je ako izračunamo  $I$  jer je jednaki u kondenzatoru

$$I=\frac{U}{R}=6,325A \rightarrow Q_C=I^2 \cdot X_C = -600 \angle -90^\circ$$

$\rightarrow$  zato kad računamo  $Q_C$  ne dodajemo  $-j$  (imao bih ne podržavajući)

nema punog smisla, samo je li kapacitivni ili induktivni

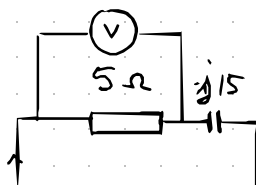
$$\Rightarrow Q_C=600VAR$$

$$P=200W$$

$$S=\sqrt{200^2+600^2}=10\sqrt{2^2+6^2}=10\sqrt{40}=20\sqrt{10} \text{ ali to je u NE-kompleksnoj obliku}$$

$$S=200W - 600VAR$$

kapacit.  
karakter



## JESEN 20./21.

① Paralelno  $Z_1=2+j4\Omega$ ,  $Z_2=4-j2\Omega$

$$P_Z=20kW$$

$$S_{uk}=?$$

$$P_2=I^2 \cdot R_e(Z_2) \Rightarrow I_2=\sqrt{\frac{P_2}{R_e}}=70,71A$$

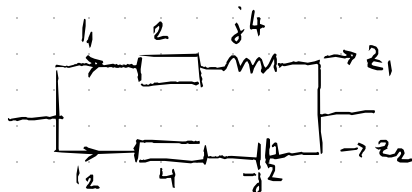
$$Q_{2L}=I_2^2 \cdot (2) = 10000VAR$$

$$U_2=I_2 \cdot Z_2 = 70,71 \cdot (4-j2\Omega)$$

$$U_2=U_1=316,22 \angle -26,57^\circ$$

$$S=\sqrt{P^2+Q^2}=100\sqrt{9+1}$$

$$S=316,23VA$$



$$I_1=\frac{U_1}{Z_1}=\frac{316,22 \angle -26,57^\circ}{2+j4}$$

$$I_1=70,71A \angle -26,57^\circ \text{ ne trebamo kut}$$

$$P_1=I_1^2 \cdot R_e \approx 10000W$$

$$Q_{1L}=20000VAR$$

$$Q_{uk}=|20kW-10kW|=10kVAR / ind.$$

$$P=30kW$$

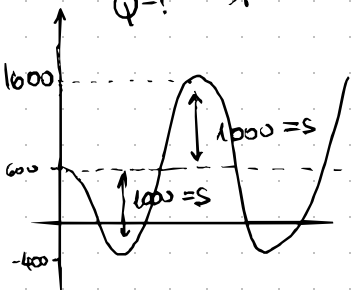
Z1 19.120.

4.

$p(t)$  doseže  $\cancel{P_{\max}} = 1600 \text{ VA}$

$\cancel{P_{\min}} = -400 \text{ VA}$

$Q = ?$

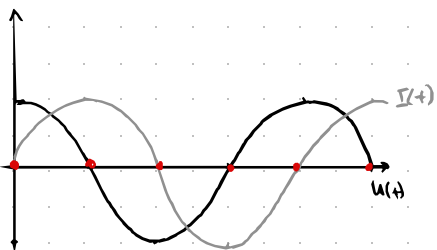


radna snaga  $P$

trošimo srednju  $S$

$$Q = \sqrt{S^2 - P^2} = \sqrt{1000^2 - 600^2}$$

$$Q = 800 \text{ VAR}$$

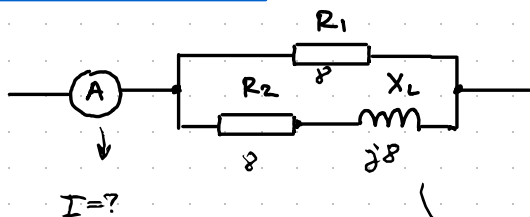


$$S = U \cdot I$$

→ kad god je 1 u 0 →  $S = 0$

$$S_R = \frac{1600 - 400}{2} = 600 \text{ VA}$$

JESEN 20./21.



$$P_{uk} = 1600 \text{ W}$$

$$R_1 = 8 \Omega$$

$$R_2 = 8 \Omega$$

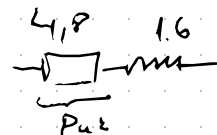
$$X_L = 8 \Omega$$

$$P_{uk} = I^2 \cdot Z_{ek}$$

$$P_1 + P_2 = 1600$$

$$Z = \left( \frac{1}{8} + \frac{1}{8 + j8} \right) = 51.05 \angle 18.43^\circ$$

$$\rightarrow Z = 4.8 + j1.6 \quad - \text{ovakvog ga možemo rastaviti.}$$



$$P = I^2 \cdot 4.8 \rightarrow I = \sqrt{\frac{1600}{4.8}} = \boxed{I = 18.26 \text{ A}}$$

## DEKANSKI 20.121

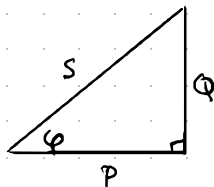
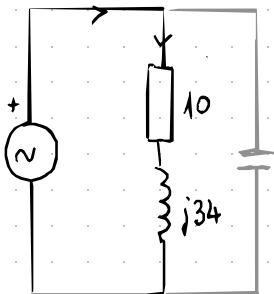
$$Z = 10 + j34 \Omega$$

$$U = 230V$$

$$f = 50 \text{ Hz}$$

$$C = ?$$

$$\cos \varphi = 0,97$$



$$\tan \varphi = \frac{Q}{P}$$

$$Q = I^2 \cdot \text{Im}(Z)$$

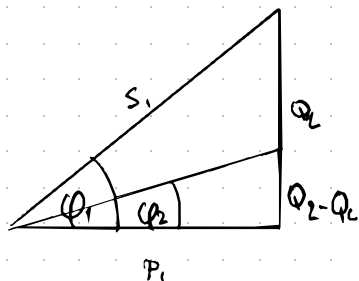
$$P = I^2 \cdot \text{Re}(Z)$$

$$I = \frac{U}{Z} = \frac{230V}{10 + j34}$$

$$I = 6,49 \angle -73^\circ \text{ A}$$

$$\rightarrow Q = 6,49^2 \cdot 34 = 1432,08 \text{ VAR}$$

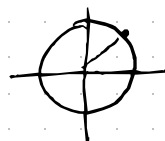
$$P = 6,49^2 \cdot 10 = 421,2 \text{ W}$$



$$\rightarrow \cos\left(\arctan\left(\frac{Q}{P}\right)\right) = \cos(73,62^\circ)$$

$$\cos = 0,28$$

→ moramo smanjiti  
kut sa  $\varphi$



kada konus raste,  
kut se smanjuje

$$\arccos(0,97) = 14^\circ$$

$$\tan \varphi_2 = \frac{Q_2}{P_1} \rightarrow \frac{Q_2 - Q_c}{P_1} = 0,25$$

$$1432,08 \text{ VAR} - Q_c = \frac{1}{4} \cdot 421,2$$

$$Q_c = 1432,08 - 105,3 = 1326,78 \text{ VAR}$$

$$Q_c = I^2 \cdot \text{Im}(Z) \quad \text{ali rebramo}$$

$$Q_c = \frac{U^2}{X_c} = \frac{U^2}{X_c}$$

$$X_c = \frac{U^2}{Q_c} = \frac{1}{\omega C}$$

$$C = \frac{Q_c}{U^2 \cdot \omega} = \frac{Q_c}{U^2 \cdot 2\pi f} = 79,84 \mu\text{F}$$

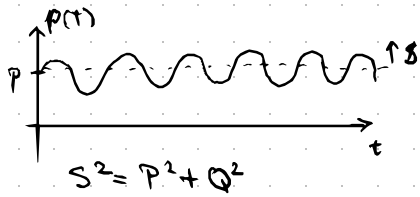
LJIR 18./19.

$$p(t) \rightarrow p_{\max} = ?$$

$$U_{ef} = 230V \rightarrow U_m = 325,27V$$

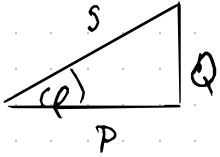
$$P = 1350W$$

$$\cos \varphi = 0,85$$



$$p(t)_{\max} = S + P$$

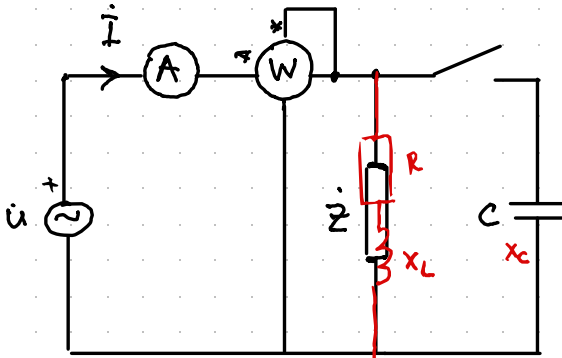
$$p(t) = 2938W$$



$$\cos \varphi = \frac{P}{S} \rightarrow S = \frac{P}{0,85}$$

$$S = 1588,24VA$$

LJIR 18/19



$$P = 100W$$

$$\hat{I} = 5A$$

$$\cos \varphi = 0,8 \text{ (ind.)}$$

$$f = 50Hz$$

$$\cos \varphi_2 = 0,95 \text{ (ind.)}$$

$$P = I^2 \cdot R \rightarrow R = 4\Omega$$

$$C = ? \quad X_C = \frac{1}{\omega C}$$

$$\arccos(0,95) = \varphi_2 = 18,19^\circ$$

$$\tan \varphi_2 = \frac{Q_L - Q_C}{P}$$

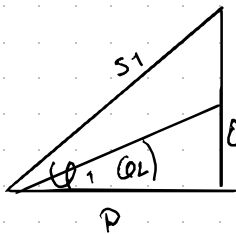
$$P \cdot \tan \varphi_2 = Q_L - Q_C$$

$$Q_C = Q_L - P \cdot \tan \varphi_2$$

$$Q_C = \frac{U^2}{X_C} \rightarrow X_C = \frac{U^2}{Q_C}$$

$$\frac{1}{\omega C} = \frac{U^2}{Q_C}$$

$$C = \frac{Q_C}{U^2 \omega} = \frac{Q_C - P \cdot \tan \varphi_2}{25^2 \cdot 2\pi f}$$



$$\varphi = \arccos(0,8) = 36,87^\circ$$

$$\varphi = 36,87^\circ$$

$$\tan \varphi = \frac{Q}{P} \rightarrow Q = P \cdot \tan \varphi$$

$$Q_L = 75,3VA$$

trebamo  $U$  da bi dobili  $Q_C$

$$\hat{U} = I \cdot \hat{Z} = \hat{I} \cdot (R + jX_L)$$

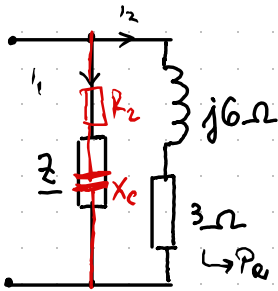
$$\hat{U} = 5(4 + 3j) = 25/36,87^\circ$$

$$Q_L = I^2 \cdot X_L$$

$$\hookrightarrow X_L = 3j$$

$$C = 216,15 \mu F$$

Zadatak koji je retko poslav



$$P_R = 666 \text{ W}$$

$$\dot{z} = ?$$

$$S_{uk} = 3370 \text{ VA}$$

$$\cos \varphi = 0,937 \text{ (кап.) (Quz } \downarrow)$$

↳ bit će kondenzator na 2 koji je JAČI  
od savojnice

$$u_1 = u_2 = u$$

$$u = \underline{z} \cdot \underline{I} \rightarrow u = \underline{z}_2 \cdot \underline{I}_2$$

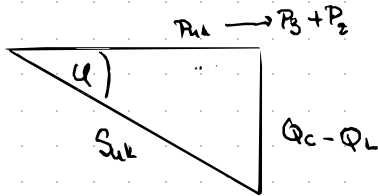
$$U = 14,9A \cdot (3 + j6)$$

$U = 100 \angle 63,4^\circ \text{ V}$

$$P_e = I^2 \cdot R_e(r) \Rightarrow I = \sqrt{\frac{660}{3}}$$

$$I_2 = 14,9 \text{ A}$$

$$Q_L = I^2 \cdot J_{mc} = \underline{1332,06 \text{ VAR}}$$



$Q = 20,44$

$$P_{uk} = S_{uk} \cdot \cos \varphi$$

Puk - 3457,69 W

$$\hookrightarrow P_2 = 2491,69$$

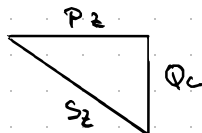
$$Q_C - Q_L = \sqrt{S_{ut}^2 + P_{ul}^2} = 1177,24 \text{ VAR} \rightarrow Q_C = 1177,24 + Q_L$$

$$Q_c = 2509,3 \text{ VA}$$

$$\hookrightarrow Q_c = \underbrace{I^2}_{\text{normale}} \cdot X_c$$

MEMORANDUM

→ novi tokovi snage



$$S_z = U \cdot I$$

$$S_2 = \sqrt{P_2^2 + Q_2^2} = \underline{\underline{35\,36,26\text{ VA}}}$$

$$I_1 = \frac{S_2}{u} = \underline{\underline{35,36 \text{ A}}}$$

$$\hookrightarrow P_z = I^2 R_e \longrightarrow R_e = 2 \Omega$$

$$Q_c = I^2 \cdot X_c \rightarrow X_c = 2$$

$$z = 2 - 2j$$