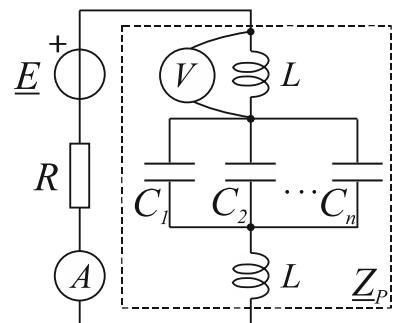


## ZADACI

**Zadatak 1.** U mreži prostoperiodične struje, prikazane na slici 1:

- Odrediti koliko kondenzatora je vezano paralelno u prijemniku  $Z_P$ , sastavljenom od reaktivnih elemenata, ako se zna da ampermetar pokazuje najveću moguću jačinu struje u kolu. Naponski generator radi na učestanosti  $\omega$ .
- Odrediti pokazivanje idealnih mernih instrumenata, pri izračunatom broju kondenzatora.
- Odrediti kompleksnu snagu generatora i reaktivnu snagu jednog kondenzatora.

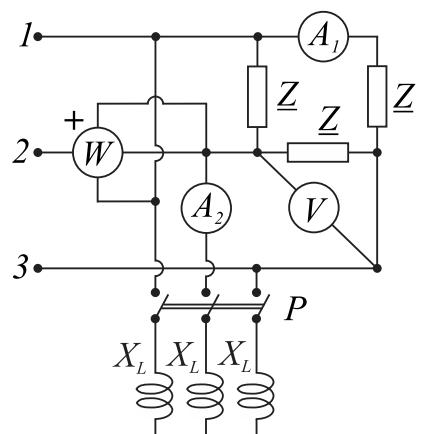
Brojne vrednosti su:  $E = j10 \text{ V}$ ,  $\omega = 5 \cdot 10^4 \text{ rad/s}$ ,  $L = 1 \text{ mH}$ ,  $C_1 = C_2 = C_n = 100 \text{ nF}$ ,  $R = 0,5 \text{ k}\Omega$



Slika 1.

**Zadatak 2.** U simetričnom trofaznom sistemu, prikazanom na slici 2, faktor snage trofaznog, pretežno kapacitivnog prijemnika je 0,707, a moduo njegove impedanse iznosi  $Z = 23 \Omega$ . Prijemnik je priključen na mrežu faznog napona  $U_1 = 230 \text{ V}$ .

- Izračunati reaktanse kalemova  $X_L$  kojima se faktor snage grupe povećava na jedinicu.
- Odrediti pokazivanja idealnih instrumenata pre i posle priključenja kalemova.
- Skicirati fazorski dijagram faznih napona mreže i svih fazora veličina od kojih zavise pokazivanja idealnih vatmetara.
- Odrediti aktivnu i reaktivnu snagu trofaznog prijemnika nakon popravka faktora snage.



Slika 2.

## PRAVILA POLAGANJA

Za položen kolokvijum neophodno je sakupiti više od 50% od ukupnog broja poena na zadacima. Svaki zadatak se bodoje sa 25 poena. Kolokvijum traje jedan sat i trideset minuta.

[K1]

[Z1]

a)

$$\underline{I}_A = \frac{\underline{E}}{R + \underline{Z}_P}$$

$$I_{A_{\max}} \rightarrow \underline{Z}_P = 0 \rightarrow X_P = 0$$

$$\underline{Z}_P \rightarrow \boxed{\quad}$$

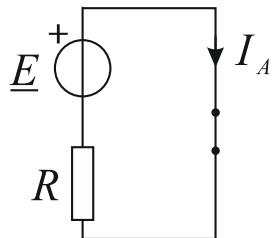
$$\underline{Z}_P = j2\omega L + \frac{1}{j\omega C \cdot n} = \frac{1 - 2 \cdot \omega^2 LC n}{j\omega C n}$$

$$1 - 2 \cdot \omega^2 LC n = 0$$

$$n = \frac{1}{2 \cdot \omega^2 LC} = \frac{1}{2 \cdot (5 \cdot 10^4)^2 \cdot 1m \cdot 100n}$$

$$\boxed{n = 2}$$

b)



$$I_A = \frac{\underline{E}}{R} = \frac{10}{0.5k}$$

$$\boxed{I_A = 20mA}$$

$$U_V = \omega L I_A = 5 \cdot 10^4 \cdot 1m \cdot 20m$$

$$\boxed{U_V = 1V}$$

c)

$$\underline{S} = \underline{E} \underline{I}^* = j10(-j20m) = 200 \text{ mVA}$$

$$\boxed{\underline{S} = 0,2 \text{ VA}}$$

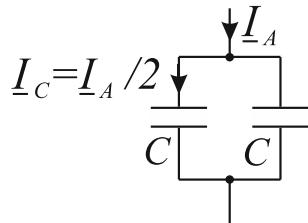
$$\underline{I}_A = \frac{\underline{E}}{R} = \frac{j10}{0.5k} = j20 \text{ mA}$$

$$\underline{S}_C = \underline{U}_C \underline{I}_C^* = \underline{Z}_C \underline{I}_C \underline{I}_C^* = \underline{Z}_C |\underline{I}_C|^2 = -jX_C \left| \frac{\underline{I}_A}{2} \right|^2$$

$$\underline{S}_C = -jX_C \left| \frac{\underline{I}_A}{2} \right|^2 = -j \frac{1}{\omega C} \left| \frac{\underline{I}_A}{2} \right|^2$$

$$\underline{S}_C = -j \frac{1}{5 \cdot 10^4 \cdot 100n} \frac{20m}{2} = -j0,02 \text{ VA}$$

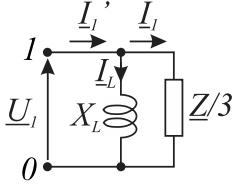
$$\boxed{Q_C = -20 \text{ mVar}}$$



K1

Z2

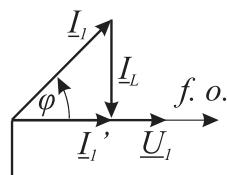
a)



$$\varphi = \arccos 0,707 = 45^\circ \quad \varphi < 0$$

$$\underline{Z} = Z e^{-j\varphi} = 23 e^{-j45^\circ} \Omega$$

$$\underline{I}_1 = \frac{\underline{U}_1}{\underline{Z}} = \frac{U_1 e^{j0^\circ}}{\frac{1}{3} Z e^{-j45^\circ}} = \frac{230}{\frac{1}{3} 23 e^{-j45^\circ}} = 30 e^{j45^\circ} \text{ A}$$



$$\underline{I}_L = \frac{\underline{U}_1}{\underline{Z}_L} = \frac{U_1 e^{j0^\circ}}{j X_L} = \frac{U_1 e^{j0^\circ}}{X_L e^{j\frac{\pi}{2}}} = \frac{U_1}{X_L} e^{-j\frac{\pi}{2}} \text{ A}$$

$$\text{IKZ: } \underline{I}_1' = \underline{I}_L + \underline{I}_1$$

$$I_L = I_1 \sin \varphi$$

$$\frac{U_1}{X_L} = \frac{U_1}{Z/3} \sin \varphi \quad \Rightarrow \quad \frac{1}{X_L} = \frac{3 \sin \varphi}{Z} \quad \Rightarrow \quad X_L = \frac{Z}{3 \sin \varphi} = \frac{23}{3 \cdot 0,707}$$

$$X_L = 10,84 \Omega$$

$$I_1' = I_1 \cos \varphi = 30 \cdot 0,707 = 21,21 \text{ A}$$

$$\underline{I}_1' = 21,21 e^{j0^\circ} \text{ A}$$

b)

$$I_{A1}^{pre} = I_{A1}^{posle} = \frac{I_1}{\sqrt{3}} = 17,32 \text{ A} \quad ili \quad I_{A1}^{pre} = I_{A1}^{posle} = \frac{U_{13}}{Z} = \frac{\sqrt{3} U_1}{Z}$$

$$\boxed{I_{A1}^{pre} = 17,32 \text{ A}}$$

$$\boxed{I_{A2}^{pre} = 0 \text{ A}}$$

$$I_{A2}^{posle} = I_L = \frac{U_1}{X_L}$$

$$\boxed{I_{A2}^{posle} = 21,21 \text{ A}}$$

$$U_V^{pre} = U_V^{posle} = |U_{23}| = \sqrt{3} |U_1| = \sqrt{3} \cdot 230$$

$$\boxed{U_V^{pre} = 398,4 \text{ V}}$$

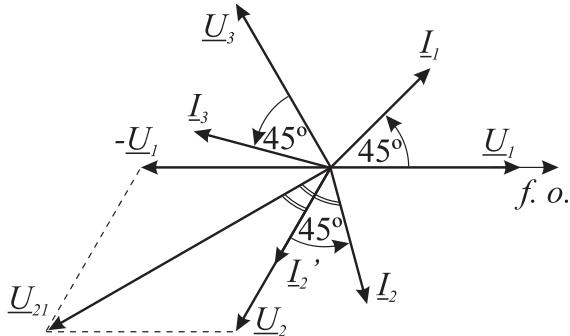
$$P_W^{pre} = \operatorname{Re} \left\{ \underline{U}_{21} \underline{I}_2^* \right\} = U_{21} I_2 \cos \varphi(\underline{U}_{21}, \underline{I}_2) = \sqrt{3} U_1 I_1 \cos(30^\circ + 45^\circ) = \sqrt{3} \cdot 230 \cdot 30 \cdot \cos 75^\circ$$

$$\boxed{P_W^{pre} = 3093,19 \text{ W}}$$

$$P_W^{posle} = \operatorname{Re} \left\{ \underline{U}_{21} \underline{I}_2'^* \right\} = U_{21} I_2' \cos \varphi(\underline{U}_{21}, \underline{I}_2') = \sqrt{3} U_1 I_1' \cos 30^\circ = \sqrt{3} \cdot 230 \cdot 21,21 \cdot \frac{\sqrt{3}}{2}$$

$$\boxed{P_W^{posle} = 7317,45 \text{ W}}$$

c)



d)

$$P_{posle} = 3 U_1 I_1' \cos \varphi' = 3 \cdot 230 \cdot 21,21 \cdot \cos 0^\circ$$

$$\boxed{P_{posle} = 14,63 \text{ kW}}$$

$$\boxed{Q_{posle} = 0 \text{ VAr}}$$