

# 2. MASOVNE INSTRUKCNE

## ZA 2. MEDVJISPIR

O. E.

$$\textcircled{1} \quad u_1(t) = 10 \sin(\omega t) V$$

$$u_2(t) = 10 \cos(\omega t) V$$

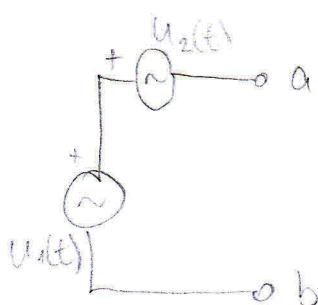
$$u_2(t) = 10 \sin\left(\omega t + \frac{\pi}{2}\right) V$$

$$u_1 = \frac{10}{\sqrt{2}} (\cos 0^\circ + j \sin 0^\circ)$$

$$u_1 = 7,07$$

$$u_2 = \frac{10}{\sqrt{2}} (\cos 90^\circ + j \sin 90^\circ)$$

$$u_2 = j \frac{10}{\sqrt{2}} = j 7,07$$



ISPIT 2008/2009.

$$u_{ab} = u_1 - u_2 = 7,07 - j 7,07$$

$$|u_{ab}| = 10 V$$

$$\operatorname{arctg}(-1) = -45^\circ$$

$$u_{ab}(t) = 10\sqrt{2} \sin\left(\omega t - \frac{\pi}{4}\right)$$

$$\textcircled{2} \quad i = 2+j2 A \quad |i| = \sqrt{2^2+2^2} = \sqrt{8} = 2\sqrt{2}$$

$$i(t) = ?$$

$$t=0$$

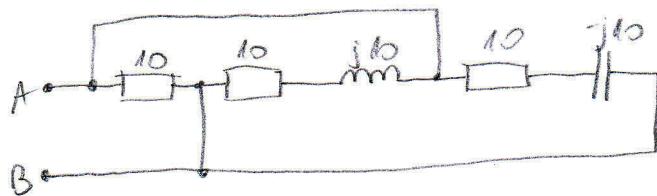
$$\operatorname{arctg}(1) = 45^\circ$$

$$i(t) = 2\sqrt{2} \cdot \sqrt{2} \sin(\omega t + 45^\circ)$$

$$i(t) = 4 \cdot \sin 45^\circ$$

$$i(t) = 2,82$$

$$(3.) \quad Z_{AB} = ?$$



$$\frac{1}{Z} = \frac{1}{10} + \frac{1}{10+10} + \frac{1}{10+10}$$

$$\frac{1}{Z} = \frac{1}{10} + \frac{10-j10+10+j10}{(10+j10)(10-j10)} = \frac{20}{200} = \frac{1}{10}$$

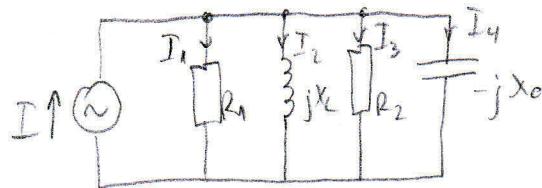
$$\frac{1}{Z} = \frac{1}{10} + \frac{1}{10} = \frac{1}{5} \quad \Rightarrow \quad Z = 5 \Omega$$

$$(4.) \quad I_1 = 1A$$

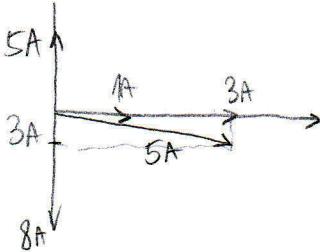
$$I_2 = 8A$$

$$I_3 = 3A$$

$$I_4 = 5A$$

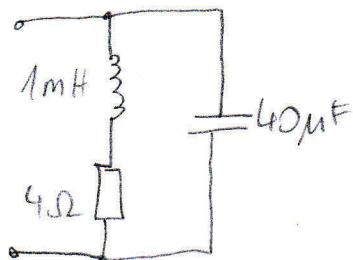


$$I = 5A$$



$$(5.) \quad \omega_{re} = ?$$

$$Z = \frac{(R+jX_L)(-jX_C)}{R+jX_L-jX_C}$$



$$R^2 X_C + X_L X_C (X_L - X_C) = 0$$

$$R^2 + X_L^2 - X_L X_C = 0$$

$$R^2 + \omega^2 L^2 - 4\omega L \frac{1}{X_C} = 0$$

$$R^2 + \omega^2 L^2 - \frac{L}{C} = 0$$

$$\omega^2 L^2 = \frac{L}{C} - R^2$$

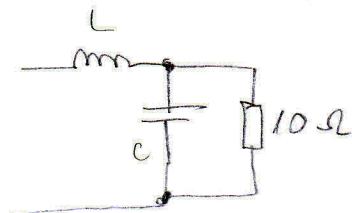
$$\omega_{re} = \sqrt{\frac{\frac{L}{C} - R^2}{L^2}} = 3000 \text{ rad/s}$$

$$Z = \frac{R X_L X_C - R X_C (X_L - X_C)}{R^2 + (X_L - X_C)} - j \frac{R^2 X_L + X_L X_C (X_L - X_C)}{R^2 + (X_L - X_C)}$$

(2)

$$6. \quad Z_{eq} = 5\Omega$$

$$X_{LC_2} = ?$$



$$Z = \frac{-jR X_C}{R^2 + X_C^2} + jX_L$$

$$Z = \underbrace{\frac{-jR^2 X_C + R X_C^2}{R^2 + X_C^2}}_{Re Z} + jX_L = \frac{R X_C^2}{R^2 + X_C^2} - j \left( \frac{R^2 X_C - X_L (R^2 + X_C^2)}{R^2 + X_C^2} \right) \underbrace{j}_{Im Z}$$

$$\frac{R X_C^2}{R^2 + X_C^2} = 5$$

$$R X_C^2 = 5R^2 + 5X_C^2$$

$$R^2 X_C - X_L (R^2 + X_C^2) = 0$$

$$10X_C^2 - 5X_C^2 = 500$$

$$100X_C - X_L (100 + 100) = 0$$

$$5X_C^2 = 500$$

$$1000 - 200X_L = 0$$

$$X_C = 10$$

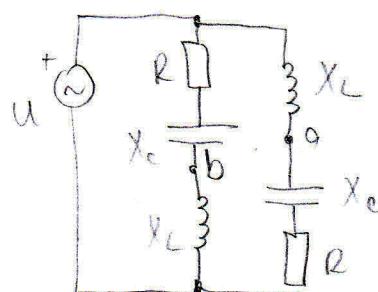
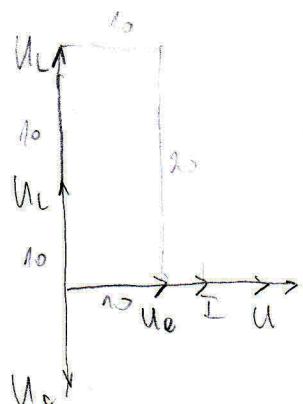
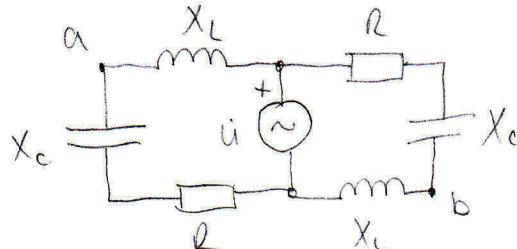
$$200X_L = 1000$$

$$X_L = 5 \Omega$$

$$7. \quad U = 10V$$

$$R = X_C = X_L = 10\Omega$$

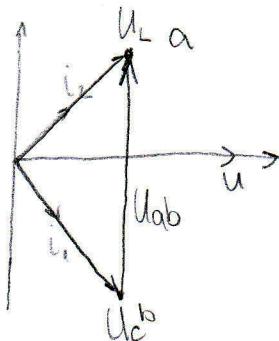
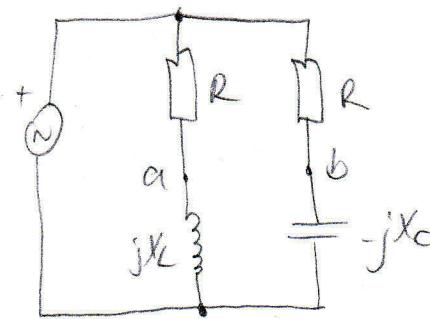
$$U_{AB} = ?$$



$$U_{AB} = \sqrt{20^2 + 10^2} = \sqrt{500} = 10\sqrt{5} V$$

3.

(8.)  $U = 100 \angle 0^\circ V$   
 $R = X_L = X_C = 100 \Omega$   
 $U_{AB} = ?$



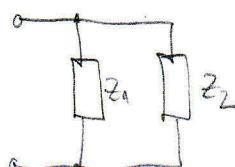
$$U_{ab} = 100 \angle 90^\circ V$$

(9.)  $Z_1 = 2 - j4$  (parallelni spoj)

$$Z_2 = 4 + j2$$

$$P(Z_1) = 10 W$$

$$Q_{vk} = ?$$



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

$$I^2 = \frac{10}{2} = 5$$

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

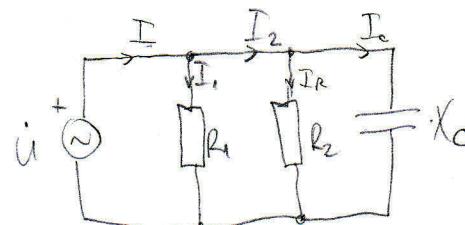
$$Q = I^2 \cdot \text{Im}(Z)$$

$$Q_1 = 5 \cdot (-4) = -20 \text{ VAR}$$

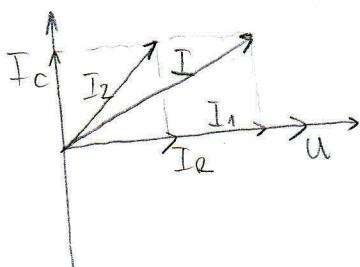
$$Q_2 = 5 \cdot 2 = 10 \text{ VAR}$$

$$Q_{vk} = Q_1 + Q_2 = -20 + 10 = -10 \text{ VAR}$$

(10.)  $I = 3 A$   
 $I_1 = 2 A$   
 $I_2 = 2 A$   
 $R_2 = 16 \Omega$



$$P = P_1 + P_2 = 9 W$$



$$\begin{aligned} I^2 &= I_c^2 + I_e^2 \quad | \cdot (-1) \\ 3^2 &= I_c^2 + (I_e + 2)^2 \Rightarrow 3^2 = I_c^2 + I_e^2 + 4I_e + 4 \end{aligned}$$

$$3^2 - 2^2 = 4I_e + 4 \quad U = U_e = I_e \cdot 16 = 4 V$$

$$I = 4I_e$$

$$I_e = \frac{1}{4} A$$

$$P_2 = \frac{U^2}{R} = \frac{16}{16} = 1 W$$

$$P_1 = U \cdot I = 4 \cdot 2 = 8 W$$

40



(1)

$$U_{ef} = 220V$$

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

nakon  $t > \frac{1}{300}$  od 1. max

$$u(t) = ?$$

$$u(t) = 220 \cdot \sqrt{2} \sin\left(\omega t + \frac{\pi}{2}\right)$$

$$u(t) = 220 \cdot \sqrt{2} \sin\left(314 \cdot \frac{1}{300} + \frac{\pi}{2}\right) = 155 \text{ V}$$

(2) -

(3)

$$u(t) = 100 \cos\left(\omega t + \frac{\pi}{2}\right) \rightarrow \dot{u} = \frac{100}{\sqrt{2}} \angle 90^\circ$$

$$i(t) = 1 \sin\left(\omega t + \frac{2\pi}{3}\right) \rightarrow i(t) = 1 \cos\left(\omega t + \frac{2\pi}{3} - \frac{\pi}{2}\right) \rightarrow \dot{i} = \frac{1}{\sqrt{2}} \angle 30^\circ$$

$$\text{Im}(z) \rightarrow \frac{\text{Im}(z)}{3}$$

$$\dot{z} = \frac{\frac{100}{\sqrt{2}} \angle 90^\circ}{\frac{1}{\sqrt{2}} \angle 30^\circ} = 100 \angle 60^\circ$$

$$z = 50 + j86,6$$

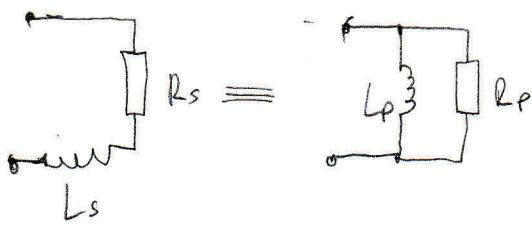
$$\dot{z}' = 50 + j28,86$$

$$\dot{z}'' = 57,7 \angle 30^\circ$$

$$\dot{I}' = \frac{\frac{100}{\sqrt{2}} \angle 90^\circ}{57,7 \angle 30^\circ} = 1,22 \angle 60^\circ \text{ A (cos)}$$

$$\dot{I}'' = 0,15\sqrt{6} \angle 150^\circ \text{ (sin)}$$

(4.)



odrediti ekvivalentne parametre paralelnog  
spojja

$$Z = R + j\omega L_s \quad (Y = G + jB_L)$$

$$\frac{1}{Z} = \frac{1}{R_s + j\omega L_s} = \frac{R_s - j\omega L_s}{R_s^2 + (\omega L_s)^2} = \frac{R_s}{R_s^2 + (\omega L_s)^2} - j \frac{\omega L_s}{R_s^2 + (\omega L_s)^2} \cdot \frac{j}{j}$$

$$\frac{1}{Z} = \frac{R}{R_s^2 + (\omega L_s)^2} + \frac{\omega L_s}{j(R_s^2 + (\omega L_s)^2)}$$

$$R_p = \frac{R_s^2 + (\omega L_s)^2}{R_s}$$

$$\omega L_p = \frac{R_s^2 + (\omega L_s)^2}{\omega L_s}$$

$$R_p = R_s + \frac{(\omega L_s)^2}{R_s}$$

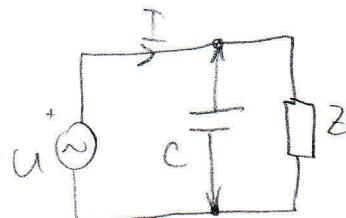
$$L_p = \frac{R_s^2}{\omega^2 L_s} + L_s$$

(5.)

$$Z = 20 \angle 30^\circ \Omega$$

$$U = 120V$$

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



$$Z = 10\sqrt{3} + j10 \Omega$$

$$Z_{uk} = Z_{uk} \angle 180^\circ = \frac{Z \cdot (-jX_c)}{Z - jX_c} \cdot \frac{Z + jX_c}{Z + jX_c} = \frac{jZ^2 X_c + Z X_c^2}{Z^2 + X_c^2} = \frac{10X_c - j10\sqrt{3}X_c}{10\sqrt{3} + j(10 - X_c)}$$

$$= \frac{-100\sqrt{3}X_c - 10\sqrt{3}X_c(10 - X_c)}{300 + (10 - X_c)^2} - j \frac{300X_c + 10X_c(10 - X_c)}{300 + (10 - X_c)^2}$$

$$\text{odrediti } \frac{-300X_c - 10X_c(10 - X_c)}{100\sqrt{3}X_c - 10\sqrt{3}X_c(10 - X_c)} = 180^\circ$$

- pri tome njezine i dobijate da je  $C = 34,8 \mu F$

$|Z|$  jedinstveno  
6.

⑤ (druží ráčin)

$$i_1 = \frac{1}{Z_1} = \frac{1}{20 \angle 30^\circ} = \frac{1}{20} \angle -30^\circ = \frac{1}{40} - j \frac{1}{40}$$

$$B_C = j B_C$$

$$i_{02} = i_1 + j B_C$$

$$Y_{02} = \frac{1}{Z_{02}} = Y_{02} \angle -18^\circ$$

$$= \frac{1}{40} - j \frac{1}{40} + j B_C$$

$$\arctg \frac{\frac{B_C}{j} - \frac{1}{40}}{\frac{\sqrt{3}}{40}} = -18^\circ$$

$$B_C = \frac{1}{X_C} = \omega C$$

$\Rightarrow$  do izracunat

⑥ -

$$⑦ \quad R = X_L = 30 \Omega$$

$$X_C = 90 \Omega$$

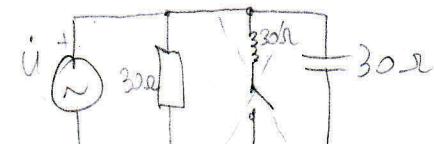
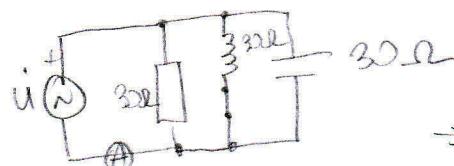
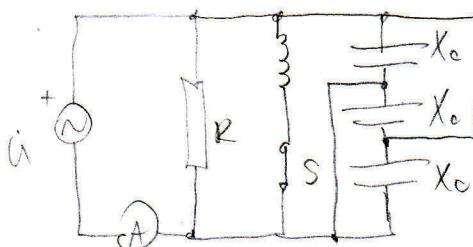
$$1) \quad I = \frac{U}{30} \rightarrow (\text{zavojena sklopka})$$

$$2) \quad Z_{02} = \frac{30(-j30)}{30-j30} = 15\sqrt{2} \angle -45^\circ$$

$$I = \frac{U}{15\sqrt{2} \angle -45^\circ}$$

$$= \frac{U}{30} \cdot \sqrt{2}$$

struja se poveća  $\sqrt{2}$  puta



1)

$\rightarrow$  rezonancija

2)

⑧

(8.)

$$U = 10V$$

$$R = 10\Omega$$

$$C = 0.5 \mu F$$

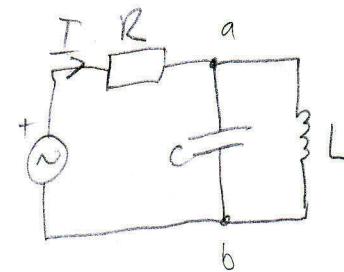
$$L = 2mH$$

$$\omega = 1000 \text{ rad/s}$$

$$X_L = \omega L = 2\Omega$$

$$X_C = \frac{1}{\omega C} = 2\Omega$$

$$I_L = ?$$



$$Z_p = \frac{j2(j2)}{j2-j2} = \infty \Omega$$

$$I = 0, U_{ab} = 10V$$

$$I_L = \frac{10}{2} = 5A$$

$$I_C = \frac{10}{j2} = -j5A$$

$$I_L = \frac{10}{j2} = j5A$$

$$0 = j5 - j5 \quad \checkmark$$

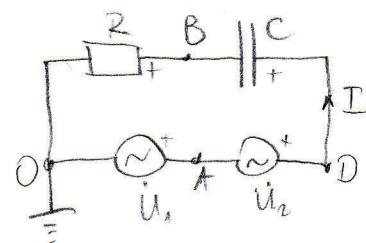
(9.)

$$U_1 = U_2 = U 10^\circ$$

$$R = 100\sqrt{3} \Omega$$

$$\omega = 1000 \text{ rad/s}$$

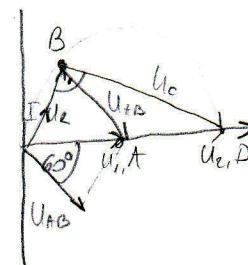
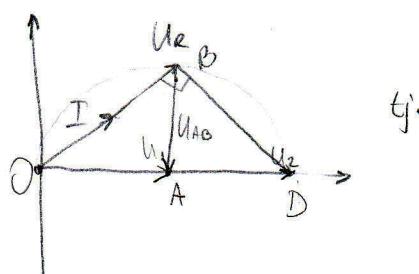
$$C = ? \rightarrow \angle(U_1, U_{AB}) = 60^\circ$$



$$U_R = U$$

$$U_R^2 + U_C^2 = (2U)^2$$

$$U_C = \sqrt{3}U$$



$$\frac{U_R}{U_C} = \frac{U}{\sqrt{3}U} = \frac{\sqrt{3}}{3} = \frac{R \cdot R}{\sqrt{3} \cdot X_C}$$

$$X_C = \frac{3R}{\sqrt{3}} = \sqrt{3}R = 300\Omega$$

$$C = \frac{1}{\omega X_C} = 3,33 \mu F$$

(8.)

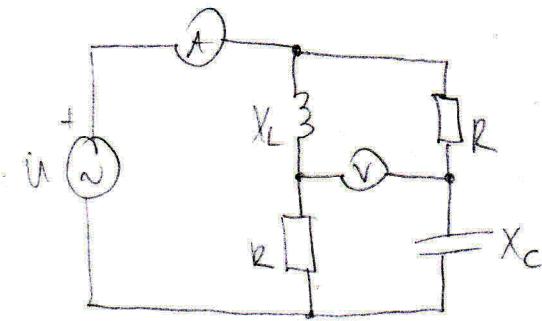
(10.)

$$R = X_L = X_C = 2 \Omega$$

$$U = 100 \angle 0^\circ V$$

$$I_+, U_V = ?$$

$$U_V = 0V \Rightarrow 2 \cdot 2 = j2(-j2)$$



$$Z_{eq} = \frac{(2+j2)(2-j2)}{2+j2+2-j2} = \frac{4+4}{4} = 2 \Omega$$

$$I_{1k} = \frac{U}{Z} = \frac{100}{2} = 50A$$

(9.)

# TEST 2006/2007

⑨.  $U = 10V$

$U_L = 6V$

$I_A = 1A$

$\angle(U, I) = 0^\circ$

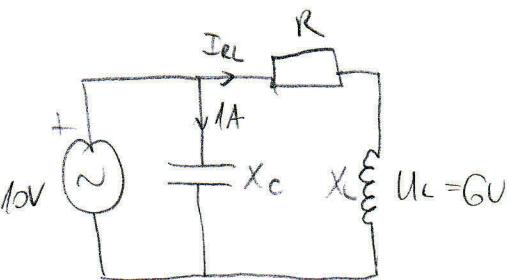
$R = ?$

$X_C = \frac{10}{I} = 10\Omega$

$U_R = \sqrt{U^2 - U_L^2} = 8V \quad \text{Im}(Z) = 0$

$$\frac{U_R}{U_L} = \frac{8}{6} = \frac{1 \cdot R \cdot R}{j \omega C \cdot X_L} = \frac{R}{X_L}$$

$3R = 4X_L$

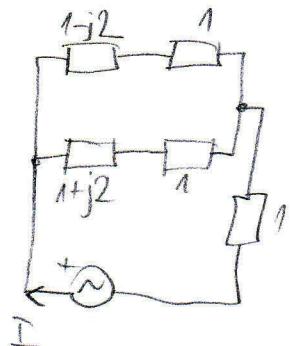
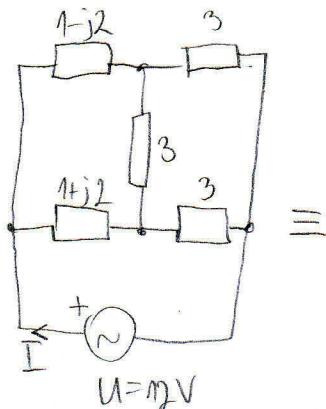


$$Z = \frac{(R + jX_C) \cdot (-jX_C)}{R + j(X_L - X_C)}$$

⑧.  $I_3 = ?$

$Z = 3\Omega$

$I = \frac{12}{3} = 4A$



⑩.

6. serijski RLC krog,  $C = 16 \mu F$ ,  $L = ?$

$$u(t) = 70,7 \sin(2500t + \frac{\pi}{4}) \rightarrow U = 50 \underline{45^\circ} V$$

$$i(t) = 2 \sin(2500t) \rightarrow I = \underline{2 \ 10^\circ A}$$

$$X_C = \frac{1}{\omega C} = 25 \Omega \quad Z_{eq} = \frac{U}{I} = \frac{50}{\sqrt{2}} \underline{45^\circ}$$

$$= 25 + j25$$

$$Z = R + j(X_L - X_C)$$
$$Z = 25 + j(50 - 25) \rightarrow \boxed{X_C = 50 \Omega}$$

(3)  $U_1 = 8 \sin(\omega t) \rightarrow U_1 = \frac{8}{\sqrt{2}}$   
 $U_2 = 6 \sin(\omega t + 90^\circ) \rightarrow U_2 = \frac{6}{\sqrt{2}} j$

$$|U| = |U_1 + U_2| = \sqrt{\frac{64}{2} + \frac{36}{2}} = \frac{10}{\sqrt{2}} \quad \boxed{U = 7V}$$

SRETNO SA AČENJEM!

:)

Masovne instrukcije odrižali: Twin & hmp

Scan by rabbit16

11.