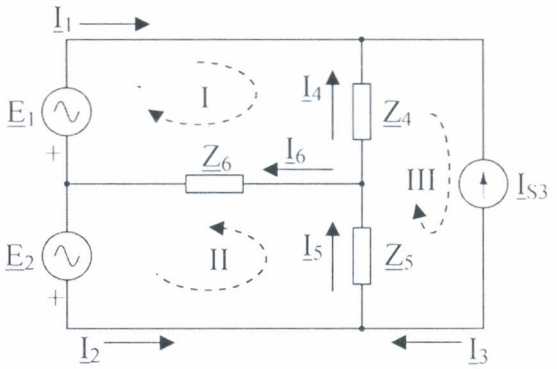
Prezime i ime: _____ Broj indeksa: _____

Profesorov prvi postulat: "Što se ne može pročitati, ne može se ni ocijeniti."

1.1. Potrebno je odrediti struju $\underline{I}_1$ u kolu sa slike direktnom primjenom metode konturnih struja. Poznato je: $\underline{E}_1 = 5 - j15$ (V), $\underline{E}_2 = 15 - j10$ (V), $\underline{I}_{S3} = -1 + j3$ (A), $\underline{Z}_4 = -\underline{Z}_5 = -j\,\underline{Z}_6 = -j5$ (Ω). **Napomena: u obzir će se uzimati samo rješenje koje uključuje metodu konturnih struja i niti jedno drugo!**

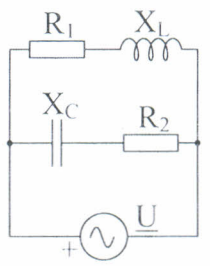
A	$\underline{I}_1 = 2\text{-}j3$ [A]	B	$\underline{I}_1 = 3\text{-}j11$ [A]
C	$\underline{I}_1 = -6+j$ [A]	D	$\underline{I}_1 = j3$ [A]
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:		



(2 boda)

1.2. Koji od datih izraza nije tačan? G_1 i B_1 su parametri grane koja sadrži R_1 i X_L. G_2 i B_2 su parametri grane koja sadrži R_2 i X_C.

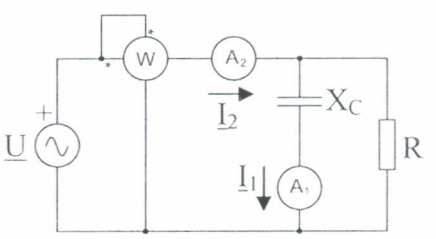
A	$G_1 = \frac{R_1}{R_1^2 + X_L^2}$	B	$G_2 = \frac{R_2}{R_2^2 + X_C^2}$
C	$B_1 = \frac{X_L}{R_1^2 + X_L^2}$	D	$B_2 = \frac{X_C}{R_2^2 + X_C^2}$
E	Svi ponuđeni odgovori su tačni.		



(1 bod)

1.3. Odrediti vrijednosti za R i X_C ako idealni instrumenti pokazuju vrijednosti $P=90$ W, $I_1=4$ A, $I_2=5$ A.

A	$R = 10\ \Omega$, $X_C = 7{,}5\ \Omega$	C	$R = 90\ \Omega$, $X_C = 22{,}5\ \Omega$
B	$R = 7{,}5\ \Omega$, $X_C = 10\ \Omega$	D	$R = 22{,}5\ \Omega$, $X_C = 90\ \Omega$
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:		



(2 boda)

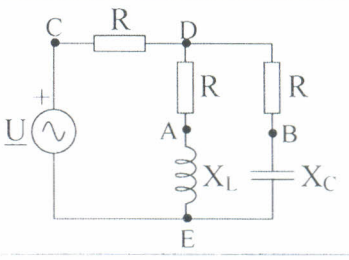
1.4. Impedansa $\underline{Z}_3 = (0 - j20)\ \Omega$ je serijski vezana sa paralenom vezom impedansi $\underline{Z}_1 = (10 + j30)\ \Omega$ i $\underline{Z}_2 = (100 + j0)\ \Omega$. Takva ekvivalentna veza je priključena na izvor prostoperiodičnog napona. Faktor snage ovog električnog kruga je:

A	$\cos\varphi = 1$.	B	$\cos\varphi = 0{,}242$	C	$\cos\varphi = 0{,}707$	D	$\cos\varphi = 0{,}950$
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:						

(2 boda)

1.5. Koja je tačna relacija koja povezuje napone $\underline{U}_{CD}$ i $\underline{U}_{AE}$? Poznato je: $\underline{U}_{DE} = U_{DE} \cdot e^{j0°}$, $R = X_L = X_C$.

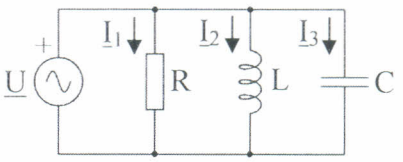
A	$\underline{U}_{AE} = \underline{U}_{CD} \cdot e^{-j\frac{\pi}{4}}$	B	$\underline{U}_{AE} = \underline{U}_{CD}\sqrt{2} \cdot e^{-j\frac{\pi}{4}}$
C	$\underline{U}_{CD} = \underline{U}_{AE} \cdot e^{-j\frac{\pi}{4}}$	D	$\underline{U}_{CD} = \underline{U}_{AE}\sqrt{2} \cdot e^{-j\frac{\pi}{4}}$
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:		



(2 boda)

1.6. Odrediti prividnu snagu izvora. Poznato je: $I_1 = 6$ (A), $I_2 = 10$ (A), $I_3 = 4$ (A), U = 100 (V).

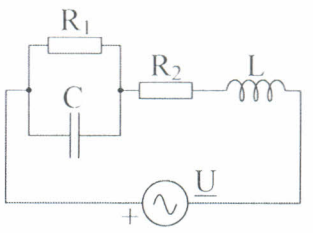
A	$\underline{S}$ =1000 + j1400 [VA]	B	$\underline{S}$ =600 + j600 [VA]
C	$\underline{S}$ =1000 - j1400 [VA]	D	$\underline{S}$ =600 - j600 [VA]
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:		



(2 boda)

1.7. Za električni krug prikazan na slici poznato je: $u(t) = 100\sqrt{2} \cdot \sin\left(\omega t + \frac{\pi}{4}\right)$ [V]; $R_1 = R_2 = 40$ [Ω]; $L = 20$ [mH]; $C = 40$ [μF]. Odrediti frekvenciju generatora pri kojoj će u električnom krugu nastupiti naponska rezonancija i efektivnu vrijednost ukupne struje kola u tom slučaju.

A	ω=927,03 [rad/s]	B	ω=102,03 [rad/s]
C	ω=1280,87 [rad/s]	D	ω=279,45 [rad/s]
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:		



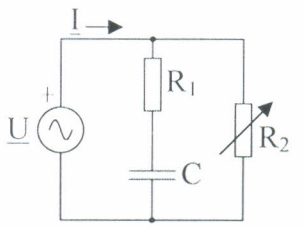
(1 bod)

A	I=2,3 [A]	B	I=1,9 [A]	C	I=1,3 [A]	D	I=2,5 [A]	E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:

(1 bod)

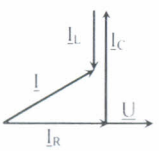
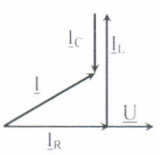
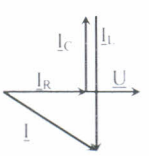
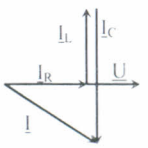
1.8. U električnom krugu prikazanom na slici, otpornost R_2 se smanji dva puta. Fazni pomak između referentnog fazora napona izvora $\underline{U}$ i fazora struje $\underline{I}$ pri tome:

A	se povećava.	B	se prvo povećava, a zatim se smanjuje.
C	se smanjuje.	D	ostaje nepromijenjen.
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:		



(1 bod)

1.9. Paralelni spoj radnog otpora otpornosti R, zavojnice reaktanse X_L i kondenzatora reaktanse X_C priključen je na naponski izvor prostoperiodičnog napona U. Svi elementi kruga su idealni, a pri tome vrijedi $X_L > X_C$. Ako se napon u električnom krugu označi sa $\underline{U}$, struja kroz otpornik sa $\underline{I}_R$, struja kroz zavojnicu sa $\underline{I}_L$, a struja kroz kondenzator označi sa $\underline{I}_C$, tačan fazorski dijagram napona i struje za ovaj električni krug prikazan je na slici:

A		B		C		D	
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:						

(1 bod)

1.10. U serijskom R-L-C kolu je nastupila naponska rezonansa. Zaokružiti tačan odgovor!

A	Naponi na L i C imaju isti fazni stav jer kroz njih protiče ista struja.
B	Napon na L fazno kasni za ugao 90° u odnosu na napon na R.
C	Napon na C fazno prednjači za ugao 90° u odnosu na napon na R.
D	Napon na R fazno prednjači za ugao 90° u odnosu na napon na C.

(1 bod)

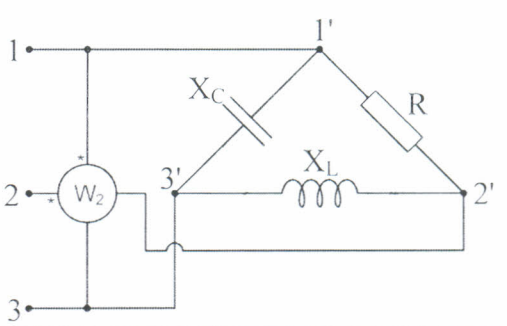
1.11. Uravnoteženi simetrični aktivni potrošač u spoju zvijezda bez nultog vodiča je priključen na trofazni simetrični izvor direktnog redoslijeda faza. Zaokružiti tačnu tvrdnju uz obrazloženje.

A	Linijski naponi potrošača imaju veće amplitude od faznih napona za faktor $\sqrt{3}$ i kasne fazno za ugao $\pi/6$ u odnosu na odgovarajuće fazne napone potrošača.
B	Linijski naponi potrošača imaju manje amplitude od faznih napona za faktor $\sqrt{3}$ i kasne fazno za ugao $\pi/6$ u odnosu na odgovarajuće fazne napone potrošača.
C	Linijske struje potrošača imaju veće amplitude od faznih struja za faktor $\sqrt{3}$ i prednjače fazno za ugao $\pi/6$ u odnosu na odgovarajuće fazne struje potrošača.
D	Linijski naponi potrošača imaju veće amplitude od faznih napona za faktor $\sqrt{3}$ i prednjače fazno za ugao $\pi/6$ u odnosu na odgovarajuće fazne napone potrošača.

(1 bod)

1.12. Trofazni potrošač u spoju trougao, priključen je na trofazni simetričnu mrežu inverznog redoslijeda linijskih napona efektivne vrijednosti $U_l = 400\ (V)$. Odrediti za koliko se promijeni očitanje idealnog watt-metra ukoliko se redoslijed linijskih napona mreže promijeni u direktni. Poznato je $R = 2X_L = X_C = 20\ (\Omega)$.

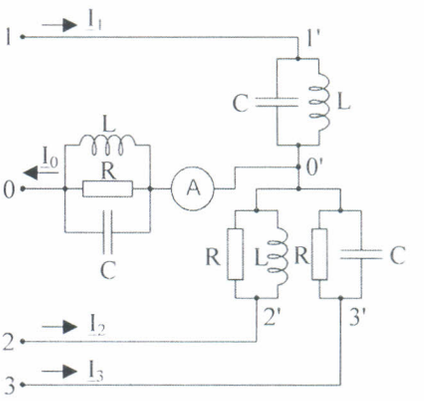
A	$\Delta P = 8000\,[W]$	B	$\Delta P = 0\,[W]$
C	$\Delta P = -4000\,[W]$	D	$\Delta P = 4000\,[W]$
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:		



(1 bod)

1.13. Četvorožični trofazni sistem sa slike je priključen na trofaznu simetričnu mrežu direktnog redoslijeda faza, efektivne vrijednosti faznog napona U_f. U sistemu je postignut uslov $R = \omega L = 1/\omega C$. Odrediti pokazivanje idealnog ampermetra.

A	$I_A = \frac{U_f}{3R}\left(1+\sqrt{3}\right)$
B	$I_A = \frac{U_f}{3R}\left(-1+\sqrt{3}\right)$
C	$I_A = \frac{U_f}{R}\left(1+\sqrt{3}\right)$
D	$I_A = \frac{U_f}{R}\left(-1+\sqrt{3}\right)$
E	Niti jedan od prethodno ponuđenih odgovora nije tačan. Tačan odgovor je:



(2 boda)

	Upisati tačan odgovor			Upisati tačan odgovor	
Zadatak 1			Zadatak 7b		
Zadatak 2			Zadatak 8		
Zadatak 3			Zadatak 9		
Zadatak 4			Zadatak 10		
Zadatak 5			Zadatak 11		
Zadatak 6			Zadatak 12		
Zadatak 7a			Zadatak 13		
UKUPNO					

1.1.)

$\underline{E}_1 = 5 - j15$

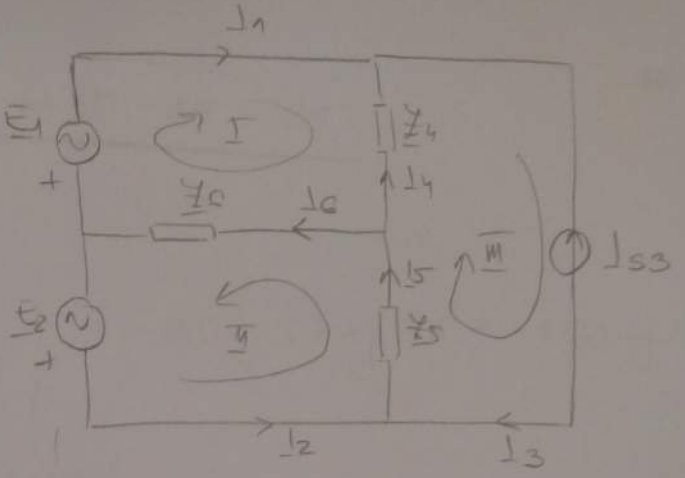
$\underline{E}_2 = 15 - j10$

$\underline{J}_{s3} = -1 + j3$

$\underline{Z}_4 = -\underline{Z}_5 = -j\underline{Z}_6 = -j5$

---

struje?



$\underline{Z}_4 = -j5$

$-\underline{Z}_5 = -j5 \Rightarrow \underline{Z}_5 = j5$

$-j\underline{Z}_6 = -j5 \Rightarrow Z_6 = 5$

$\underline{Z}_{11} = \underline{Z}_4 + \underline{Z}_6 = 5 - j5$

$\underline{Z}_{22} = \underline{Z}_6 + \underline{Z}_5 = 5 + j5$

$\underline{Z}_{12} = \underline{Z}_6 = 5$

$\underline{Z}_{23} = \underline{Z}_5 = j5$

$\underline{Z}_{13} = -\underline{Z}_4 = j5$

$\underline{J}_{3k} = -\underline{J}_{s3} = 1 - j3$

I: $-5 + j15 = (5 - j5)\underline{J}_{1k} + 5\underline{J}_{2k} + j5\underline{J}_{3k}$

$15 - j10 = 5\underline{J}_{1k} + (5 + j5)\underline{J}_{2k} + j5\underline{J}_{3k}$

$-5 + j15 - j5(1 - j3) = (5 - j5)\underline{J}_{1k} + 5\underline{J}_{2k}$

$15 - j10 - j5(1 - j3) = 5\underline{J}_{1k} + (5 + j5)\underline{J}_{2k}$

$-5 + j15 - 15 - j5 = (5 - j5)\underline{J}_{1k} + 5\underline{J}_{2k}$

$15 - j10 - 15 - j5 = 5\underline{J}_{1k} + (5 + j5)\underline{J}_{2k}$

$-20 + j10 = (5 - j5)\underline{J}_{1k} + 5\underline{J}_{2k}$

$-j15 = 5\underline{J}_{1k} + (5 + j5)\underline{J}_{2k}$

$$D = \begin{vmatrix} 5-j5 & 5 \\ 5 & 5+j5 \end{vmatrix} = 50 - 25 = 25$$

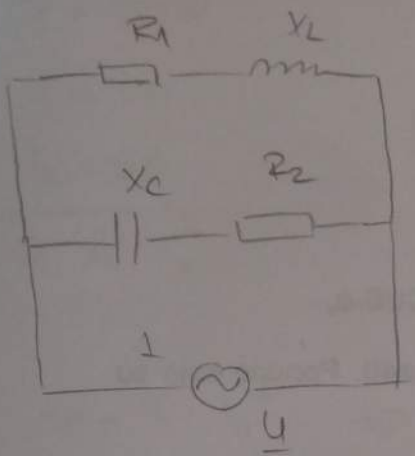
$$D_{I1k} = \begin{vmatrix} -20+j10 & 5 \\ -j15 & 5+j5 \end{vmatrix} = -150 - j50 + j75 = -150 + j25$$

$$D_{I2k} = \begin{vmatrix} 5-j5 & -20+j10 \\ 5 & -j15 \end{vmatrix} = -75 - j75 + 100 - j50 = 25 - j150$$

$$\underline{I}_{1k} = \frac{D_{I1k}}{D} = -6 + j$$

$$\underline{I}_{1k} = \underline{I}_1 \Rightarrow \boxed{\underline{I}_1 = -6 + j \ (A)} \Rightarrow \text{(c) w}$$

1.2.)



$$\underline{Y} = G + jB$$

$$\underline{Y}_1 = \frac{1}{\underline{Z}_1} = \frac{1}{Z_1 + jX_L} \cdot \frac{Z_1 - jX_L}{Z_1 - jX_L} = \frac{Z_1 - jX_L}{Z_1^2 + X_L^2}$$

$$G_1 = \frac{Z}{Z_1^2 + X_L^2} \quad ; \quad B_1 = \frac{-X_L}{Z_1^2 + X_L^2}$$

$$\underline{Y}_2 = \frac{1}{\underline{Z}_2} = \frac{1}{Z_2 - jX_C} \cdot \frac{Z_2 + jX_C}{Z_2 + jX_C} = \frac{Z_2 + jX_C}{Z_2^2 + X_C^2}$$

$$G_2 = \frac{Z_2}{Z_2^2 + X_C^2} \qquad B_2 = \frac{X_C}{Z_2^2 + X_C^2}$$

→ B_1 nije tačan ⇒ (c) N

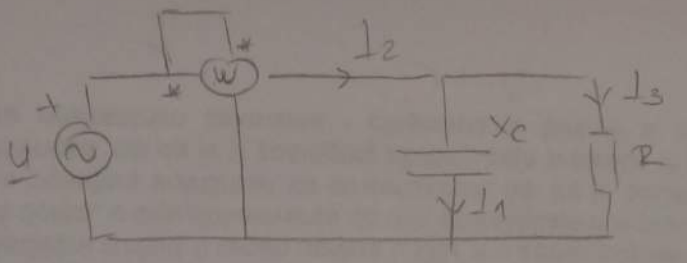
1.3.)

$P = 90W$

$I_1 = 4A$

$I_2 = 5A$

$R, X_C = ?$



$$P = R \cdot I_3^2 \Rightarrow R = \frac{P}{I_3^2}$$

$$\underline{I}_3 = \underline{I}_2 - \underline{I}_1$$

$$\underline{I}_1 = 4 \cdot e^{j90} = j4$$

$$\underline{I}_3 = I_3 \cdot e^{j0} = I_3$$

$$\underline{I}_2 = \underline{I}_1 + \underline{I}_3 = I_3 + j4 = I_2(\cos\varphi + j\sin\varphi) = I_3 + j4$$

$$I_3 = I_2 \cdot \cos\varphi \quad ; \quad I_1 = I_2 \cdot \sin\varphi \Rightarrow \sin\varphi = \frac{I_1}{I_2}$$

$$\varphi = 53{,}13° \Rightarrow \cos\varphi = 0{,}6$$

$$P = U \cdot I_2 \cdot \cos\varphi \Rightarrow U = \frac{P}{I_2 \cos\varphi} = 30V$$

$$I_3 = 3A$$

$$R = \frac{P}{I_3^2} = \frac{90}{9} \Rightarrow \boxed{R = 10\,\Omega}$$

$$X_C = \frac{U}{I_1} = \frac{30}{4} \Rightarrow \boxed{X_C = 7{,}5\,\Omega}$$

$\Rightarrow$ (A) W

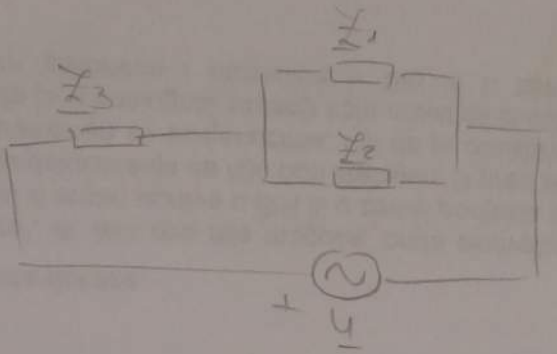
2.4.)

$\underline{Z}_3 = -j20$

$\underline{Z}_1 = 10 + j30$

$\underline{Z}_2 = 100$

$\cos\varphi = ?$



$$\underline{Z}_{12} = \frac{100\,(100+j30)}{100+100+j30} = \frac{10000+j3000}{200+j30} \cdot \frac{200-j30}{200-j30}$$

$$\underline{Z}_{12} = \frac{2090000+j300000}{40900} = 51{,}10 + j7{,}33$$

$$Z_{ex} = 51{,}10 + j7{,}33 - j20 = 51{,}10 - j12{,}67 = 52{,}64 \cdot e^{-j13{,}92}$$

$$\varphi = \operatorname{arctg}\frac{-12{,}67}{51{,}10} = -13{,}92^\circ$$

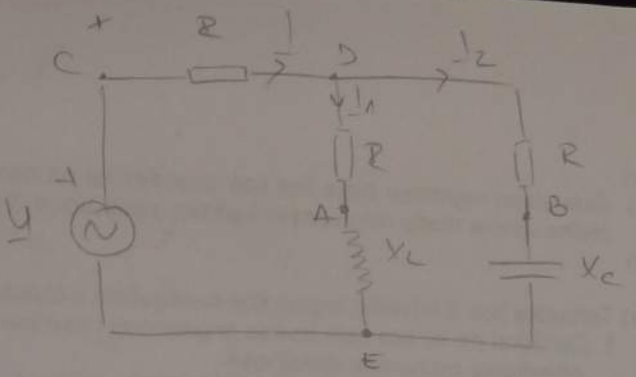
$\boxed{\cos\varphi = 0{,}97}$ $\Rightarrow$ (E)

3.5.)

$\underline{U}_{DE} = U_{DE} \cdot e^{j0°}$

$R = X_L = X_C$

$\underline{U}_{CD}, \underline{U}_{AE} = ?$



$\underline{I} = \underline{I}_1 + \underline{I}_2$

$\underline{U}_{CD} = \underline{I} \cdot R$; $\underline{U}_{DE} = \underline{I}_1 \cdot (R + jX_L) = \underline{I}_1 \cdot R(1+j) =$

$= U_{DE}(1+j)$

$\underline{U}_{AE} = \underline{I}_1 \cdot jX_L$; $\underline{I}_1 = \frac{\underline{U}_{DE}}{R + jX_L}$

(*) $\underline{U}_{AE} = \frac{\underline{U}_{DE}}{R + jX_L} \cdot jX_L = \frac{jU_{DE} \cdot R}{R(1+j)} = \frac{jU_{DE}}{1+j}$

$\underline{U}_{AE} = U_{DE} \cdot \frac{j}{1+j} \cdot \frac{1-j}{1-j} = U_{DE} \cdot (0{,}5 + j0{,}5) =$

$= U_{DE} \cdot 0{,}707 \cdot e^{j45°}$

$\underline{I}_2 = \frac{\underline{U}_{DE}}{R - jX_C} \cdot \frac{R + jX_C}{R + jX_C} = \frac{U_{DE} \cdot R(1+j)}{2R^2} = \frac{U_{DE}(1+j)}{2R}$

$\underline{I} = \underline{I}_1 + \underline{I}_2 = \frac{U_{DE}(1-j)}{2R} + \frac{U_{DE}(1+j)}{2R} = \frac{U_{DE} - jU_{DE} + U_{DE} + jU_{DE}}{2R}$

$\underline{I} = \frac{2U_{DE}}{2R} \Rightarrow I = \frac{U_{DE}}{R}$

$$\underline{U}_{CD} = 1 \cdot R = \frac{\underline{U}_{DE}}{R} \cdot R$$

$$\Rightarrow \quad \underline{U}_{CD} = \underline{U}_{DE}$$

$$\Rightarrow \boxed{\underline{U}_{AE} = U_{CD} \cdot 0{,}707 \cdot e^{j45^\circ} \ (V)} \Rightarrow \text{A i C mișcă bâlci}$$

$$(*) \Rightarrow \quad \underline{U}_{AE} = \frac{U_{DE}}{R + jX_L} \cdot jX_L \quad / (R + jX_L)$$

$$\underline{U}_{AE}(R + jX_L) = jU_{DE}X_L \qquad (U_{CD} = U_{DE}) \Rightarrow$$

$$\Rightarrow \underline{U}_{AE}(R + jX_L) = j\underline{U}_{CD}X_L \Rightarrow$$

$$\underline{U}_{CD} = \frac{-j\underline{U}_{AE}(R + jX_L)}{X_L} = \frac{-j\underline{U}_{AE} \cdot R(1 + j)}{R}$$

$$\underline{U}_{CD} = -j\underline{U}_{AE}(1 + j) = e^{-j90^\circ} \cdot \underline{U}_{AE}(1 + j) =$$

$$= e^{-j90^\circ} \cdot \underline{U}_{AE} \cdot \sqrt{2} \cdot e^{j45^\circ} \Rightarrow$$

$$\boxed{\underline{U}_{CD} = \underline{U}_{AE}\sqrt{2} \cdot e^{-j45^\circ} \ (V)} \Rightarrow \text{(D) W}$$

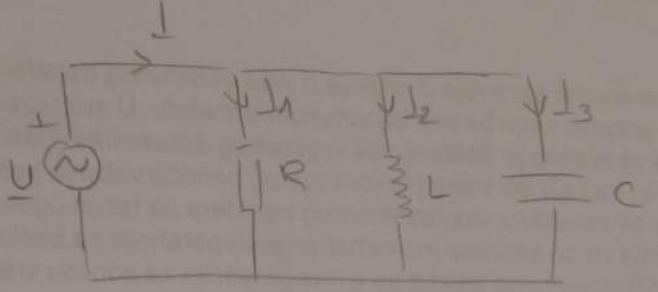
1.6.)

$I_1 = 6A$

$I_2 = 10A$

$I_3 = 4A$

$U = 100V$



$\underline{S} = ?$

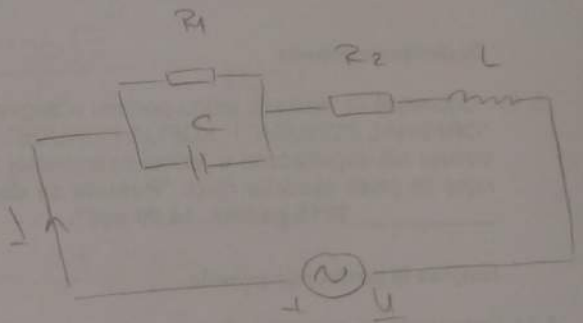
$$\left.\begin{aligned} \underline{I}_1 &= 6 \cdot e^{j0^\circ} = 6 \\ \underline{I}_2 &= 10 \cdot e^{-j90^\circ} = -j10 \\ \underline{I}_3 &= 4 \cdot e^{j90^\circ} = j4 \end{aligned}\right\} \Rightarrow \underline{I} = \underline{I}_1 + \underline{I}_2 + \underline{I}_3 = 6 - j6$$

$$\underline{U} = 100 \cdot e^{j0^\circ}$$

$$\underline{S} = \underline{U} \cdot \underline{I}^* = 100(6+j6)$$

$$\boxed{\underline{S} = 600 + j600 \ [VA]} \Rightarrow (B)\ W$$

1.7.)



$u(t) = 100\sqrt{2}\sin(\omega t + 45^\circ)$

$R_1 - R_2 = 40\,\Omega$

$L = 20\,mH = 0{,}02\,H$

$C = 40\,\mu F = 0{,}00004\,F$

naponska rezonansa

$\omega_1 = ?$

$\lim_{\omega} \{Z_{ek}\} = 0$

$\underline{Z}_{ek} = \underline{Z}_1 + \underline{Z}_2$

$$\underline{Z}_1 = \frac{R_1\left(-j\frac{1}{\omega C}\right)}{R_1 - j\frac{1}{\omega C}} = \frac{-j\frac{R_1}{\omega C}}{\frac{R_1\omega C - j}{\omega C}} = \frac{-jR_1}{R_1\omega C - j} \cdot \frac{R_1\omega C + j}{R_1\omega C + j}$$

$$\underline{Z}_1 = \frac{R_1 - jR_1^2\omega C}{R_1^2\omega^2 C^2 + 1}$$

$$\underline{Z}_2 = R_2 + j\omega L$$

$$\underline{Z}_{ek} = \frac{R_1}{R_1^2\omega^2 C^2 + 1} + R_2 + j\underbrace{\left(\omega L - \frac{R_1^2\omega C}{R_1^2\omega^2 C^2 + 1}\right)}_{0}$$

$$\frac{R_1^2\omega C}{R_1^2\omega^2 C^2 + 1} = \omega L \Rightarrow R_1^2 C = R_1^2\omega^2 C^2 L + L$$

$$\omega^2 = \frac{R_1^2 C - L}{R_1^2 C^2 L} = \frac{0{,}044}{0{,}000000051} = 862745{,}098$$

$$\omega = 928{,}84\ \frac{rad}{s} \approx \text{(A) } \omega$$

$$I = \frac{U}{Z_{ek}} \; ; \qquad U = \frac{100\sqrt{2}}{\sqrt{2}} = 100\,V$$

$$\underline{Z}_{ek} = \frac{40}{3,20} + 40 + j\left(18,54 - \frac{59,32}{3,20}\right)$$

$$\underline{Z}_{ek} = 52,5 + j\,0$$

(Što je logično jer je u toku napajanja rezonanca, pa je $\underline{Z}_{ek} = Re\{Z_{ek}\}$)

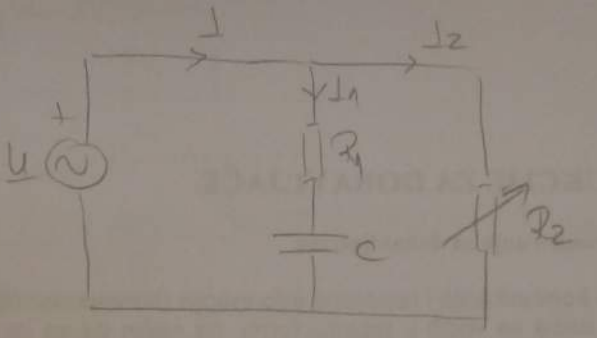
$$I = \frac{100}{52,5} = 1,90\ A \Rightarrow$$ (B)

1.8)

1° $R = R_2$

2° $R' = \frac{R_2}{2}$

$\varphi = ?$



$$\underline{Z}_{ec} = \frac{\underline{Z}_1 \underline{Z}_2}{\underline{Z}_1 + \underline{Z}_2}$$

$\underline{Z}_1 = R_1 - jX_C$; $\underline{Z}_2 = R$

$$\underline{Z}_{ec} = \frac{R(R_1 - jX_C)}{R + R_1 - jX_C} = \frac{RR_1 - jRX_C}{(R+R_1) - jX_C} \cdot \frac{(R+R_1) + jX_C}{(R+R_1) + jX_C} =$$

$$= \frac{R^2R_1 + RR_1^2 - jR^2X_C - jRR_1X_C + jRR_1X_C + RX_C^2}{(R+R_1)^2 + (X_C)^2} =$$

$$= \frac{R^2R_1 + RR_1^2 + RX_C^2}{(R+R_1)^2 + X_C^2} + j\,\frac{RR_1X_C - R^2X_C - RR_1X_C}{(R+R_1)^2 + X_C^2}$$

$$\varphi = \operatorname{arctg} \frac{RR_1X_C - R^2X_C - RR_1X_C}{R^2R_1 + RR_1^2 + RX_C^2}$$

1° $R = R_2 = 1$; $R_1 = 1$; $X_C = 2$

$\varphi = \operatorname{arctg} \frac{1 - 1 - 2}{1 + 1 + 4} = \frac{-2}{6} = -18,43 \rightarrow$

2° $R = \frac{R_2}{2} = 0,5$; $R_1 = 1$; $X_C = 2$

$\varphi = \operatorname{arctg} \frac{1 - 0,5 - 1}{0,25 + 0,5 + 2} = \frac{-0,5}{2,75} = -10,30° \rightarrow$

$\Rightarrow$ φ zmaleje $\Rightarrow$ ©w

1.9.)

$X_L > X_C$

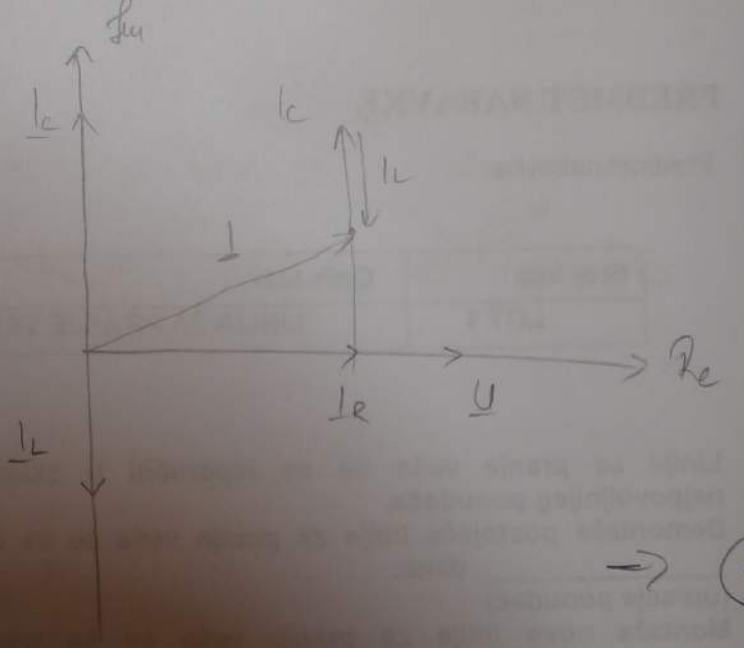
$$\underline{U} = U \cdot e^{j0°}$$

$$\underline{I}_R = I_R \cdot e^{j0°} = \frac{U}{R} \cdot e^{j0°}$$

$$\underline{I}_C = I_C \cdot e^{j90°} = \frac{U}{X_C} \cdot e^{j90°}$$

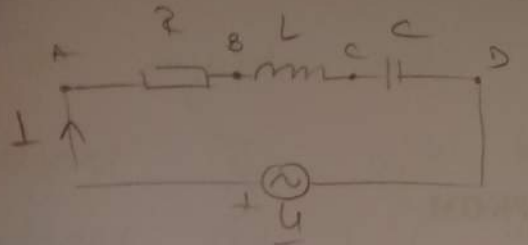
$$\underline{I}_L = I_L \cdot e^{-j90°} = \frac{U}{X_L} \cdot e^{j90}$$

$X_L > X_C \Rightarrow I_L < I_C$



→ (A) W

3.10.)



$$\underline{U} = U \cdot e^{j0^\circ}$$

$$\underline{Z} = R + j(X_L - X_C)$$

$$I = \frac{U}{R} = \frac{U \cdot e^{j0^\circ}}{R}$$

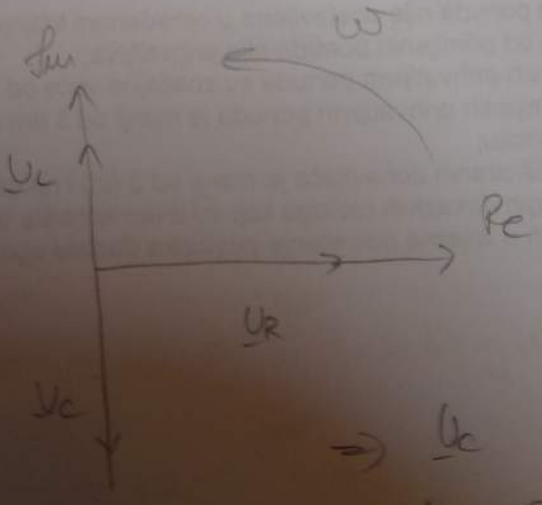
$$X_L = X_C$$

$$I = I \cdot e^{j0^\circ}$$

$$\underline{U}_{AB} = \underline{U} = U \cdot e^{j0^\circ} = \underline{U}_R$$

$$\underline{U}_{BC} = \underline{I} \cdot jX_L = I \cdot e^{j0^\circ} \cdot X_L \cdot e^{j90} = U_{BC} \cdot e^{j90^\circ} = \underline{U}_L$$

$$\underline{U}_{CD} = \underline{I} \cdot (-jX_C) = I \cdot e^{j0^\circ} \cdot X_C \cdot e^{-j90} = U_{CD} \cdot e^{-j90^\circ} = \underline{U}_C$$



$\Rightarrow$ $\underline{U}_C$ kasni za $\underline{U}_R$

$\Rightarrow$ $\underline{U}_L$ prednjači $\underline{U}_R$

$\Rightarrow$ (D) U

1.11.)

- Za zvijezdu važi $I_L = I_F$ i $U_L = \sqrt{3} U_F$

⇒ Odgovor (C) nije tačan.

⇒ Odgovor (B) nije tačan (linijski napon je veći)

⇒ linijski naponi prednjače za ugao od 30°

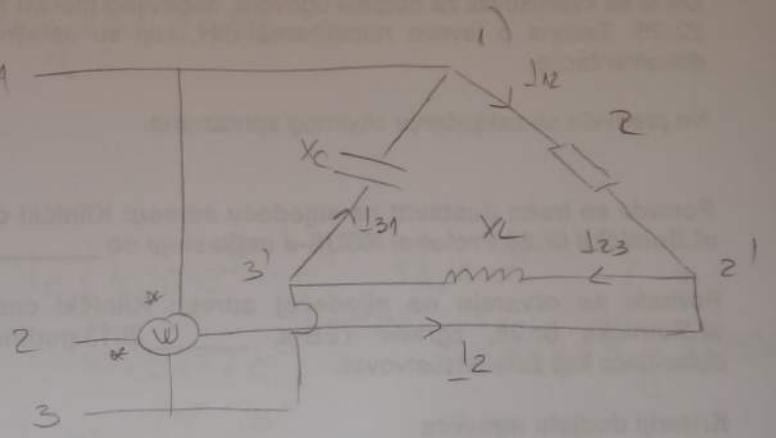
→ (D) U

1.12.)

$U_L = 400V$

$R = 2X_L = X_C = 20\Omega$

$\Delta P = ?$



→ Trokut ⇒ $U_L = U_F$; $I_L = \sqrt{3} I_F$

d.r.f.

$\underline{U}_{12}' = 400 \cdot e^{j0°}$

$\underline{U}_{23}' = 400 \cdot e^{-j120°}$

$\underline{U}_{31}' = 400 \cdot e^{j120°}$

i.u.v. red. f.

$\underline{U}_{12}'' = 400 \cdot e^{j0°}$

$\underline{U}_{23}'' = 400 \cdot e^{j120°}$

$\underline{U}_{31}'' = 400 \cdot e^{-j120°}$

$\underline{I}_2 + \underline{I}_{12} = \underline{I}_{23} \Rightarrow \underline{I}_2 = \underline{I}_{23} - \underline{I}_{12}$

$\underline{I}_{23}' = \frac{\underline{U}_{23}'}{X_L \cdot e^{j90°}} = \frac{400 \cdot e^{-j120°}}{10 \cdot e^{j90°}} = 40 \cdot e^{-j210°} = -34,64 + j20$

$\underline{I}_{23}'' = \frac{\underline{U}_{23}''}{X_L \cdot e^{j90°}} = \frac{400 \cdot e^{j120°}}{10 \cdot e^{j90°}} = 40 \cdot e^{j30°} = 34,64 + j20$

$$\underline{I}_{12}' = \frac{\underline{U}_{12}'}{R} = \frac{400}{20} = 20$$

$$\underline{I}_{12}'' = \frac{\underline{U}_{12}''}{R} = 20$$

$$\underline{I}_2' = -34{,}64 + j20 - 20 = -54{,}64 + j20 = 58{,}18 \cdot e^{j159{,}89°}$$

$$\underline{I}_2'' = 34{,}64 + j20 - 20 = 14{,}64 + j20 = 24{,}78 \cdot e^{j53{,}79°}$$

$$P_w' = Re\left\{ \underline{U}_{13}' \cdot \underline{I}_2'^{*} \right\} = Re\left\{ 400 \cdot e^{j120°} \cdot e^{j180°} \cdot 58{,}18 \cdot e^{j159{,}89} \right\} =$$

$$= 23272 e^{j459{,}89} = -3997{,}13 + j\,22926{,}16$$

$$P_w'' = Re\left\{ \underline{U}_{13}'' \cdot \underline{I}_2''^{*} \right\} = \left\{ 400 \cdot e^{j120°} \cdot e^{j180°} \cdot 24{,}78 \cdot e^{j53{,}79} \right\} =$$

$$= 9912 \cdot e^{j113{,}79°} = -3998{,}35 + j\,9069{,}77$$

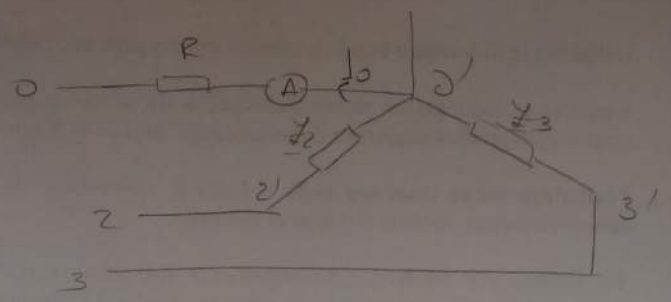
$$\Delta P = P_w' - P_w'' = -4000 - (-4000) = 0\ W \Rightarrow \text{(B) } W$$

13.) d.r.f.

U_F

$R = \omega L = \frac{1}{\omega C}$

$I_A = ?$



$$\underline{I_A} = \underline{I_0} = \frac{\underline{U_{0'0}}}{R}$$

$$\underline{Z_2} = \frac{R(j\omega L)}{R + j\omega L} = \frac{jR^2}{R + jR} = \frac{jR^2}{R(1+j)} = \frac{jR}{1+j} \cdot \frac{1-j}{1-j} =$$

$$= \frac{R + jR}{2} = \frac{R(1+j)}{2}$$

$$\underline{Z_3} = \frac{R(1-j)}{2} \quad ; \quad \underline{Z_1} \to \infty$$

$$\underline{U_{10}} = U_F \cdot e^{j0^\circ} \quad ; \quad \underline{U_{20}} = U_F \cdot e^{j120^\circ} \quad ; \quad \underline{U_{20}} = U_F \cdot e^{j120^\circ}$$

$$\underline{U_{0'0}} = \frac{\frac{\underline{U_{10}}}{\underline{Z_1}} + \frac{\underline{U_{20}}}{\underline{Z_2}} + \frac{\underline{U_{30}}}{\underline{Z_3}}}{\frac{1}{\underline{Z_1}} + \frac{1}{\underline{Z_2}} + \frac{1}{\underline{Z_3}} + \frac{1}{\underline{Z_0}}} = \frac{\frac{2U_F \cdot e^{j30^\circ}}{R(1+j)} + \frac{2U_F \cdot e^{j120^\circ}}{R(1-j)}}{\frac{2}{R(1+j)} + \frac{2}{R(1-j)} + \frac{1}{R}} =$$

$$= \frac{\frac{-U_F - j\sqrt{3}U_F}{(1+j)} + \frac{-U_F + j\sqrt{3}U_F}{(1-j)}}{\frac{2}{(1+j)} + \frac{2}{(1-j)} + 1} = \frac{\frac{(-U_F - j\sqrt{3}U_F)(1-j) + (-U_F + j\sqrt{3}U_F)(1+j)}{(1+j)(1-j)}}{\frac{2(1-j) + 2(1+j) + (1+j)(1-j)}{(1+j)(1-j)}} =$$

$$= \frac{-U_F + jU_F - j\sqrt{3}U_F - \sqrt{3}U_F - U_F - jU_F + j\sqrt{3}U_F - \sqrt{3}U_F}{2 - j2 + j2 + 1 - j + j + 1}$$

$$\underline{U_{o'o}} = \frac{-2U_F - 2\sqrt{3}U_F}{6} = \frac{-2U_F(1+\sqrt{3})}{6} =$$

$$= \frac{-U_F(1+\sqrt{3})}{3} = \frac{U_F(-1-\sqrt{3})}{3}$$

$$\underline{I_o} = \frac{U_F(-1-\sqrt{3})}{3R} = \frac{U_F}{3R} \cdot (1+\sqrt{3}) \cdot e^{j180^\circ}$$

$$\Rightarrow \boxed{I_A = \frac{U_F}{3R}(1+\sqrt{3})\ (A)} \Rightarrow \text{(A) W}$$