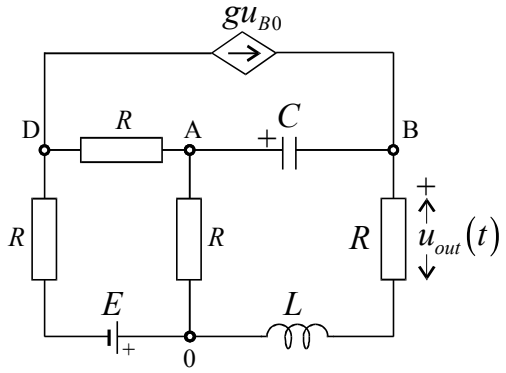
ELEKTRIJADA – 2013.

Zadatak 1.

Električno kolo sa naponski kontrolisanim strujnim izvorom, prikazano na slici 1., radi kao oscilator napona, $u_{out} = 6\sqrt{3}\sin(t)$ V.

Ako je poznato: $E = 9$ V, $R = 18$ Ω, $L = 9\sqrt{3}$ (vremenski normirana vrednost), odrediti provodnost parametra kontrole g i kapacitivnost kondenzatora C (vremenski normirana vrednost).

Analizu električnog kola isključivo raditi u vremenskom domenu.



Slika 1.

ELECTRICAL CIRCUIT THEORY

Task 1.

An electrical circuit with a voltage–controlled current source, shown in Fig. 1, works as an oscillator circuit. The time function of output voltage is, $u_{out} = 6\sqrt{3}\sin(t)$ V.

If you are familiar with: $E = 9$ V, $R = 18$ Ω, $L = 9\sqrt{3}$ (time-normalized value), determine the conductivity of parameter control g and capacitance of capacitor C (time-normalized value).

Electrical circuit is to be analised exclusively in the time domain.

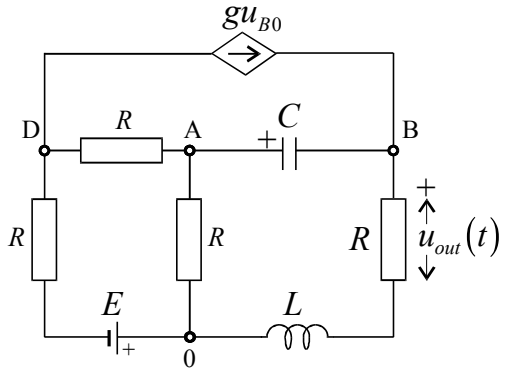


Fig. 1.

Zadatak 2.

Na ulaz električnog kola prikazanog na slici 2. deluje složenoperiodični naponski generator koji sadrži prvi i treći harmonik. Poznata je vrednost otpornosti R_1, $R_1 = 30\ \Omega$ i reaktanse reaktivnih elemenata za osnovnu kružnu učestanost ω: $X_{L2} = 2R_1$, $X_M = 0{,}5R_1$, $X_{C1} = 1{,}5R_1$, $X_{C2} = 4{,}5R_1$.

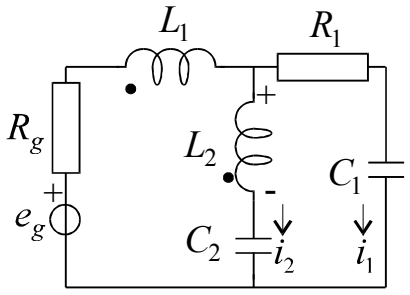
Ako je poznata vremenska funkcija napona na induktivitetu L_2,

$$u_{L2}(t) = 30\sqrt{2}\sin(\omega t + \pi) + 27\sqrt{2}\sin\left(3\omega t + \frac{\pi}{4}\right)\ \text{V},$$

odrediti:

a/ vremenske funkcije struja naznačenih na slici 1., $i_1(t)$, $i_2(t)$;

b/ otpornost otpornika R_g ako je njegova aktivna snaga $P_{Rg} = 119$ W.



Slika 2.

ELECTRICAL CIRCUIT THEORY

Task 2.

The harmonic voltage source acts upon the input of the electric circuit shown in the Fig. 2, containing the first (fundamental) and third harmonic. The resistance of the resistor R_1 and the reactance of the named reactive elements for the fundamental harmonic are:

$R_1 = 30\ \Omega$, $X_{L2} = 2R_1$, $X_M = 0{,}5R_1$, $X_{C1} = 1{,}5R_1$, $X_{C2} = 4{,}5R_1$.

If voltage on the inductance L_2 is a known time function,

$$u_{L2}(t) = 30\sqrt{2}\sin(\omega t + \pi) + 27\sqrt{2}\sin\left(3\omega t + \frac{\pi}{4}\right)\ \text{V},$$

determine:

a/ time functions of currents indicated in Fig. 2, $i_1(t)$, $i_2(t)$;

b/ resistance of resistor R_g if you are familiar with its active power $P_{Rg} = 119$ W.

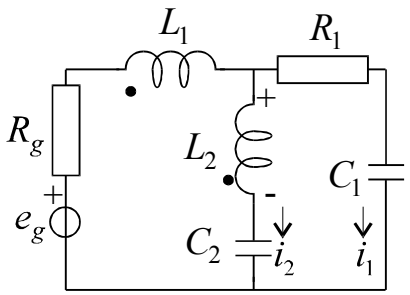


Fig. 2

Zadatak 3.

Dva voda bez gubitaka, karakteristika (R_{c1},λ_1) i (R_{c2},λ_2), služe za napajanje potrošača impedansi $Z_{p1}=2R-j\frac{R}{\sqrt{3}}$ i $Z_{p2}=R+j\sqrt{\frac{10}{3}}R$, respektivno.

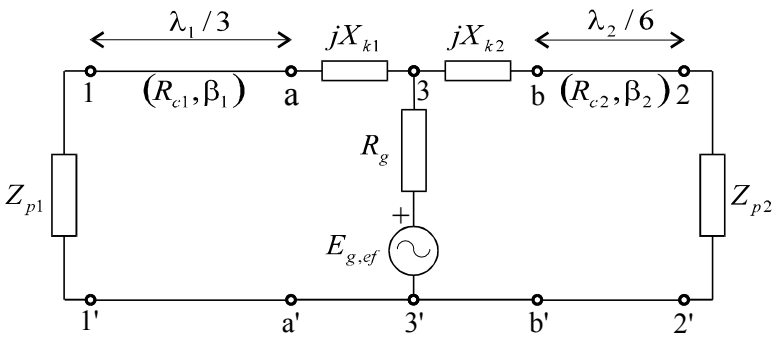
Vodovi su paralelno vezani na generator *ems* $e_g(t)=\sqrt{2}E_{g,ef}\sin\omega t$ V, unutrašnje otpornosti R_g, preko redno vezanih reaktivnih elemenata X_{k1} i X_{k2} koji služe za kompenzaciju reaktivnog dela ulaznih impedansi $Z_{aa'}$, odnosno $Z_{bb'}$. Dužine vodova naznačene su na slici 3.

Parametre vodova i potrošača, R_{c1},R_{c2},R, treba podesiti tako da:

- efektivne vrednosti napona na krajevima potrošača imaju istu vrednost, $U_{p1,ef}=U_{p2,ef}=U_{p,ef}$,
- odnos otpornosti $\frac{R}{R_{c1}}=x$ obezbeđuje jednoznačno rešenje za odnos otpornosti $\frac{R_{c2}}{R_{c1}}=a$.

Koristeći gore navedene uslove izračunati $R,R_{c1},R_{c2},X_{k1},X_{k2},U_{p,ef}$ i X_{k1},X_{k2} po iznosu i znaku.

Predpostavlja se da su poznate vrednosti za E_g,R_g.



Slika 3.

ELECTRICAL CIRCUIT THEORY

Task 3.

Two lossless transmission lines of the characteristic (R_{c1},λ_1) and (R_{c2},λ_2) are used for the power supply of two consumers with the impedance $Z_{p1}=2R-j\frac{R}{\sqrt{3}}$ and $Z_{p2}=R+j\sqrt{\frac{10}{3}}R$, respectively.

Lossless transmission lines are parallel connected on independent sinusoidal voltage generator ems $e_g(t)=\sqrt{2}E_{g,ef}\sin\omega t$ [V] and internal resistance R_g to the input port (3,3'), through the serially connected reactance X_{k1} and X_{k2} that serve to compensate reactive part of two input impedance $Z_{aa'}$, $Z_{bb'}$, respectively. Transmission line lengths are indicated in Fig. 3.

The parameters of lossless transmission lines and consumers need to be set so that:

- rms voltages at the ends of the consumers are the same values, $U_{p1,ef}=U_{p2,ef}=U_{p,ef}$,
- resistance ratio $\frac{R}{R_{c1}}=x$ provides an unique solution for the resistance ratio $\frac{R_{c2}}{R_{c1}}=a$.

Using the above criteria determine $R,R_{c1},R_{c2},X_{k1},X_{k2},U_{p,ef}$ and the amount and reactive character of X_{k1},X_{k2}.

It is assumed that E_g,R_g are the known values.

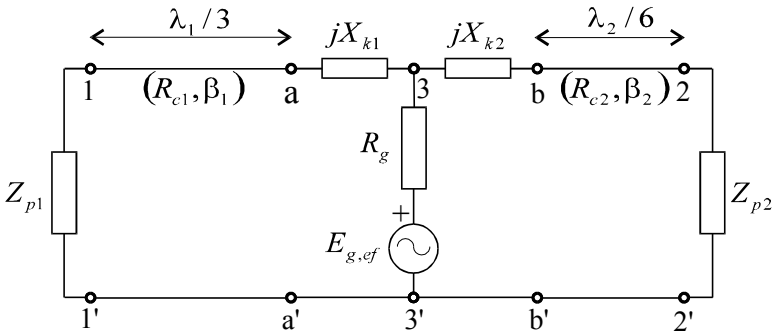


Fig. 3