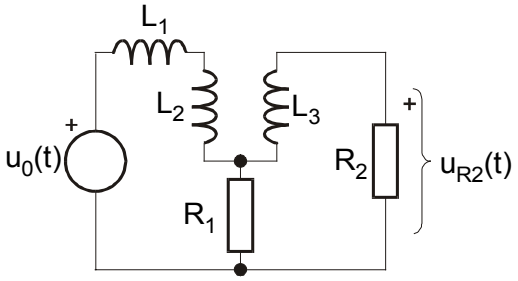
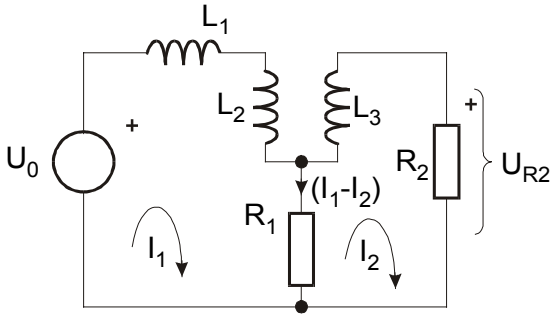
1.A. Za mrežu prikazanu slikom izračunati napon $u_{R2}(t)$ ako su zadane normalizirane vrijednosti elemenata: R_1=1, R_2=1, L_1=1, L_2=2, L_3=4 te napon generatora $u_0(t)$=*S(t)*.

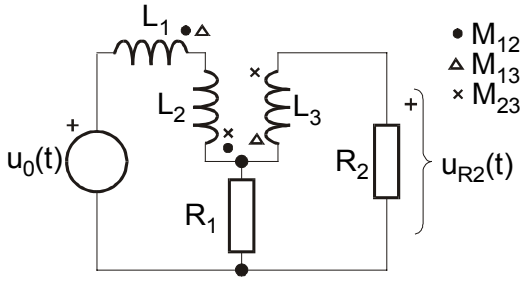


Rješenje:

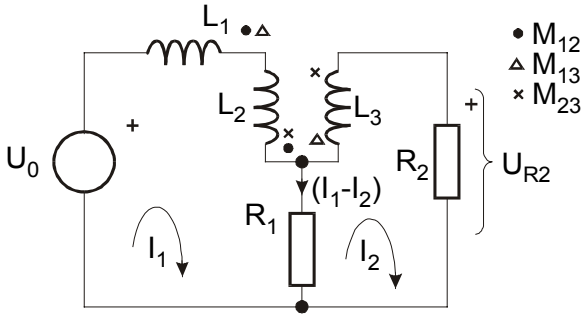


$$U_{R2}(s)=\frac{1}{s(12s^2+10s+1)} \;\Rightarrow\; u_{R2}(t)=\mathscr{L}^{-1}[U_{R2}(s)]$$

1.B. Za mrežu prikazanu slikom izračunati napon $u_{R2}(t)$ ako su zadane normalizirane vrijednosti elemenata: R_1=1, R_2=1, L_1=1, L_2=2, L_3=4, M_{12}=1/2, M_{13}=2, M_{23}=3 te napon generatora $u_0(t)$=*S(t)*.

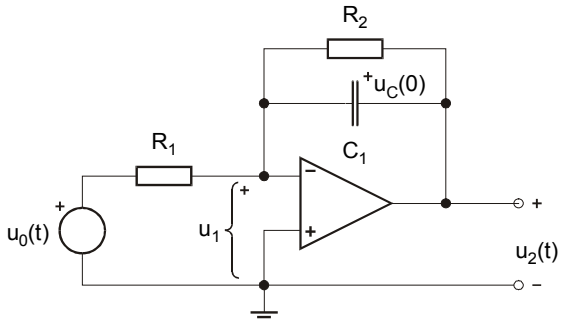


Rješenje:

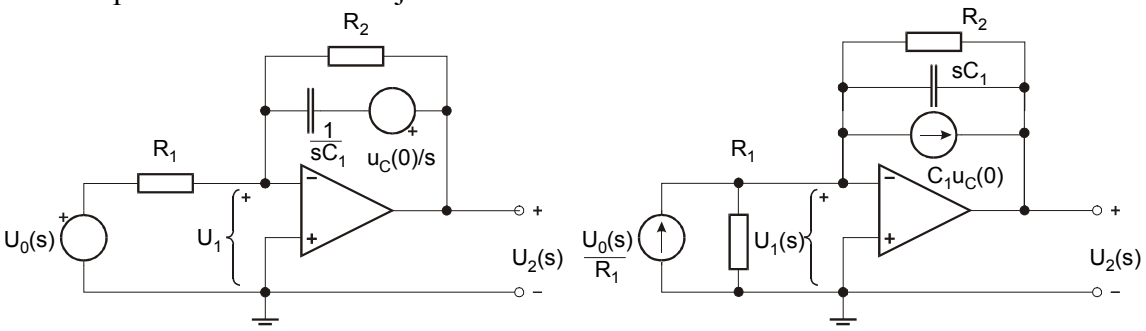


$$U_{R2}(s)=\frac{1}{s}+\frac{0.186}{(s+0.8554)}-\frac{1.186}{(s+0.0780)} \Rightarrow u_{R2}(t)=\left[1+0.186\cdot e^{-0.8554t}-1.186\cdot e^{-0.0780t}\right]\cdot S(t).$$

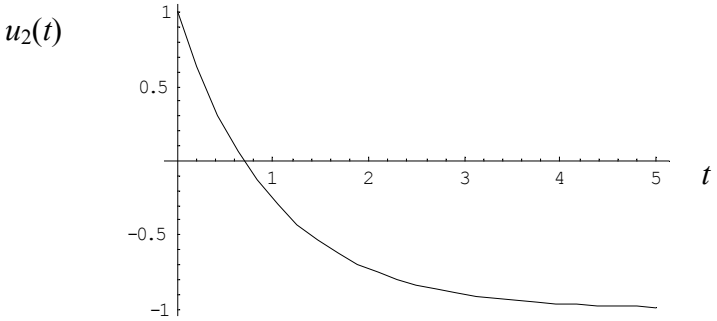
2. Za mrežu na slici odrediti i skicirati odziv napona $u_2(t)$ ako je zadano: $u_0(t) = S(t),\ R_1 = 1,\ R_2 = 1,\ C_1 = 1,\ u_C(0) = 1$. Odziv izračunati rješavanjem Laplaceove transformacije.



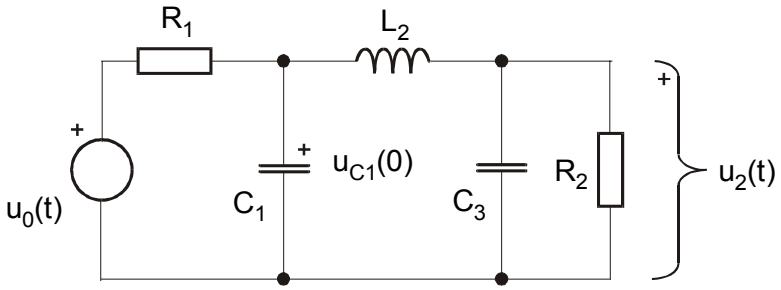
Rješenje:
Pomoću Laplaceove transformacije dobivamo:



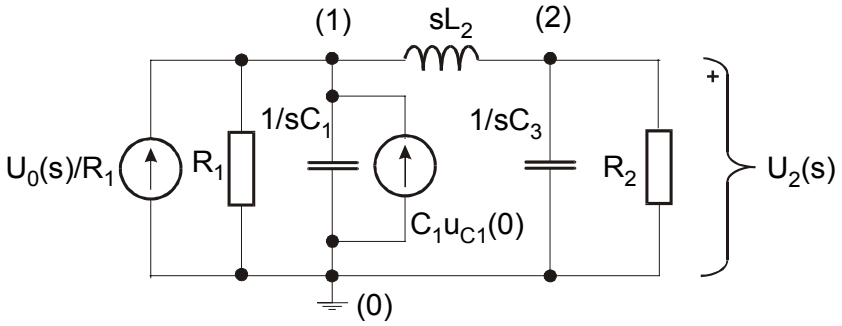
$$U_2(s) = \frac{2}{s+1} - \frac{1}{s} \ \Rightarrow\ u_2(t) = 2 \cdot e^{-t} \cdot S(t) - S(t)$$



3. Izračunati odziv napona $u_2(t)$ na otporu R_2 za mrežu prikazanu slikom. Zadano je: pobuda $u_0(t) = \delta(t)$, početni napon na kapacitetu C_1 je $u_{C1}(0) = 1$ i normalizirane vrijednosti elemenata $R_1 = R_2 = 1,\ C_1 = C_3 = 1,\ L_2 = 2$.



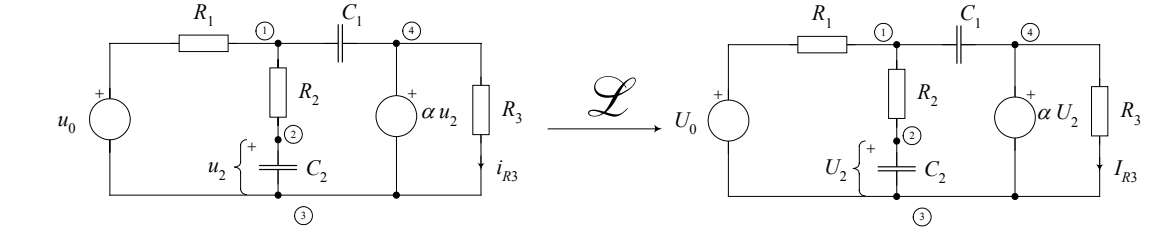
Rješenje:
Pomoću Laplaceove transformacije dobivamo:

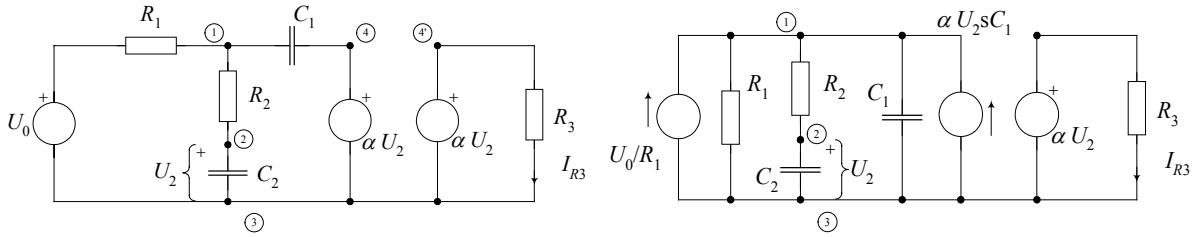


$$U_2(s)=\frac{1}{(s+1)(s^2+s+1)}$$

$$U_2(s)=\frac{1}{s+1}-\frac{s}{s^2+s+1}\ \Rightarrow\ u_2(t)=\left[e^{-t}-e^{-\frac{t}{2}}\cos\frac{\sqrt{3}}{2}t+\frac{1}{\sqrt{3}}e^{-\frac{t}{2}}\sin\frac{\sqrt{3}}{2}t\right]\cdot S(t)$$

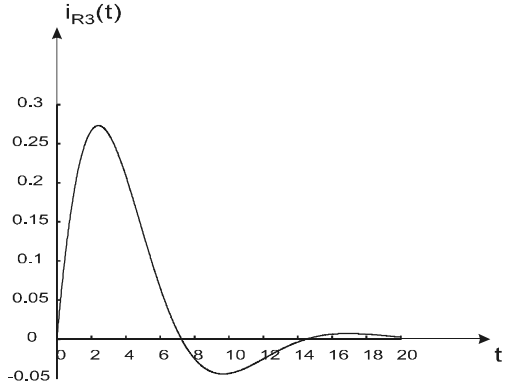
4. Odredite odziv $i_{R3}(t)$ mreže na slici ako je pobuda $u_0(t)=\delta(t)$. Zadano je: $R_1=R_2=1$, $R_3=2$, $C_1=C_2=2$, $\alpha=2$.



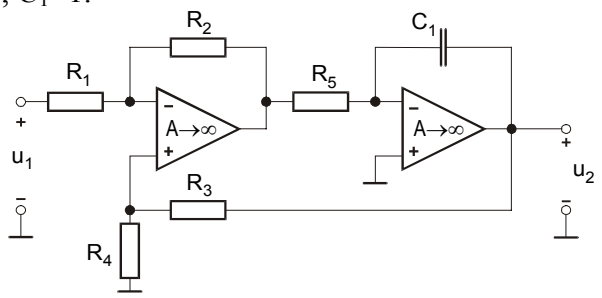


Rješenje: Primjena Laplaceove transformacije i transformacija naponskih izvora u strujne

$$i_{R3}(t)=\frac{1}{\sqrt{3}}\cdot e^{-\frac{1}{4}t}\cdot\sin\frac{\sqrt{3}}{4}t\cdot S(t)$$



5. Odrediti odziv $U_{izl}(s)$ za mrežu prikazanu slikom ako je pobuda $U_1(s)=\frac{1}{s}$. Zadano je $R_1=R_2=R_3=R_4=R_5=1$, $C_1=1$.

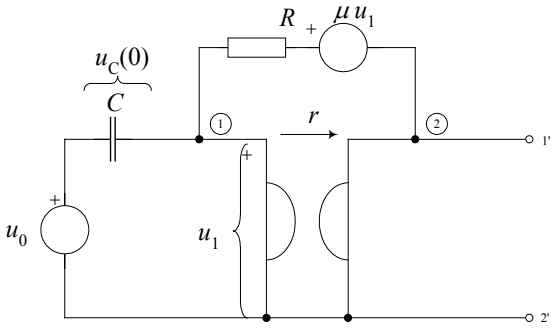


Rješenje:

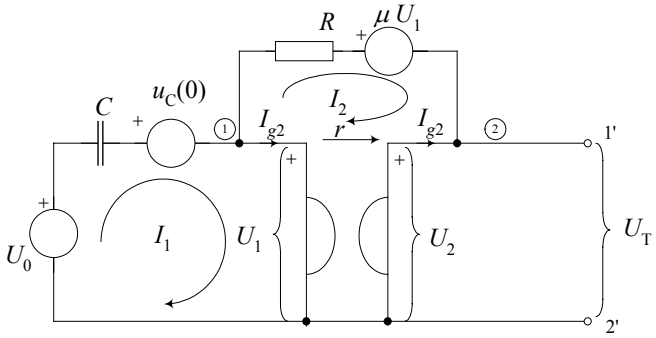
$$U_{izl}(s)=U_6(s)=\frac{R_2(R_3+R_4)}{sC_1R_1R_5(R_3+R_4)+R_4(R_1+R_2)}\cdot U_1(s)$$

$$U_{izl}(s)=U_6(s)=\frac{1\cdot(1+1)}{s\cdot1\cdot(1+1)+1\cdot(1+1)}\cdot\frac{1}{s}=\frac{2}{2s+2}\cdot\frac{1}{s}=\frac{1}{s}\cdot\frac{1}{s+1}$$

6. Za mrežu prikazanu slikom odrediti nadomjesnu shemu po Theveninu obzirom na priključnice 1-1', primjenom jednadžbi petlji, ako je pobuda $u_0(t)=S(t)$. Zadane su normirane vrijednosti elemenata: R=0.5, r=0.5, μ=0.5, C=1 i početni napon na kapacitetu $u_C(0)$=2.



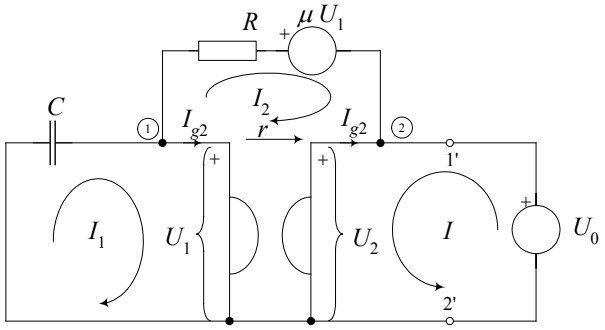
Rješenje: Primjena Laplaceove transformacije



a) Theveninov napon $U_T(s)= U_2(s)$

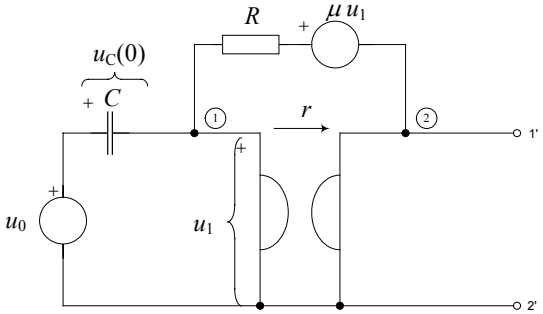
$$U_T=\frac{1}{2}\cdot\frac{1}{s+3}$$

b) Theveninova impedancija:

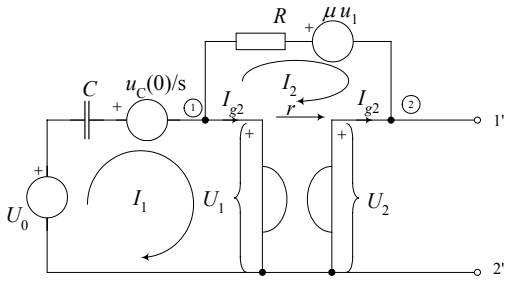


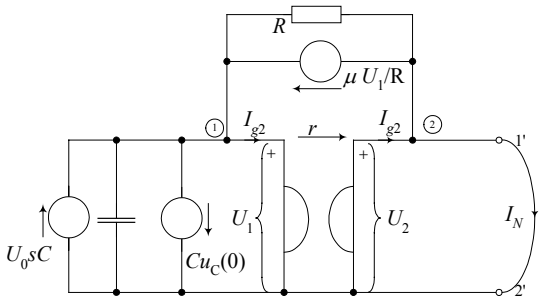
$$Z_T = \frac{U}{I} = \frac{s+1}{2(s+3)}$$

7. Za mrežu prikazanu slikom odrediti nadomjesnu shemu po Nortonu obzirom na priključnice 1-1', koristeći postupak jednadžbi čvorišta, ako je pobuda $u_0(t)=S(t)$. Zadane su normirane vrijednosti elemenata: R=0.5, r=0.5, μ=0.5, C=1 i početni napon na kapacitetu $u_C(0)$=2.



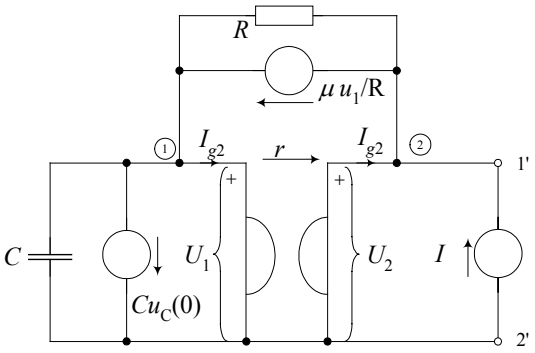
Rješenje: Primjena Laplaceove transformacije i transformacija naponskih izvora u strujne
a) Nortonova struja:





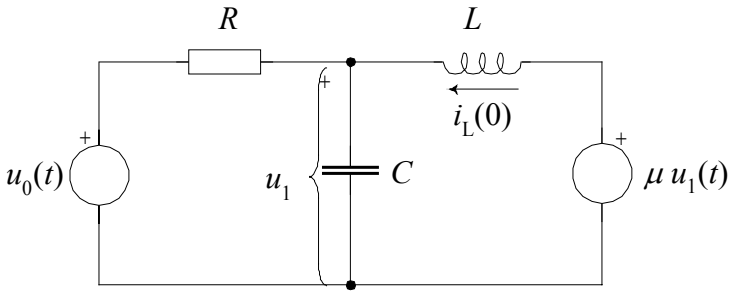
$$I_N = \frac{1}{s+1}$$

b) Nortonova admitancija:

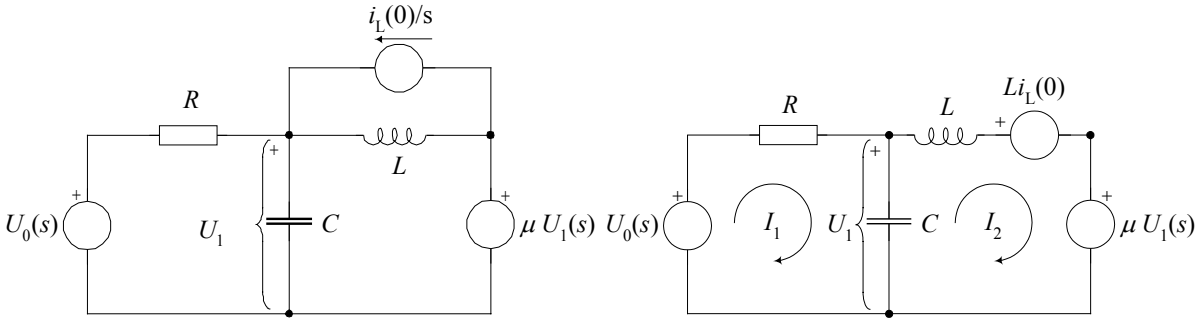


$$Y_N = 2\frac{s+3}{s+1}$$

8. Za mrežu prikazanu slikom napisati jednadžbe petlji. Konačni oblik jednadžbi prikazati u formi matrične jednadžbe. Izračunati napon $U_1(s)$, ako je zadana pobuda $u_0(t)$= S(t), μ=2/3, početna struja kroz induktivitet $i_L(0)$=1 i normirane vrijednosti elemenata: R=1, L=1/2 i C=1/3.

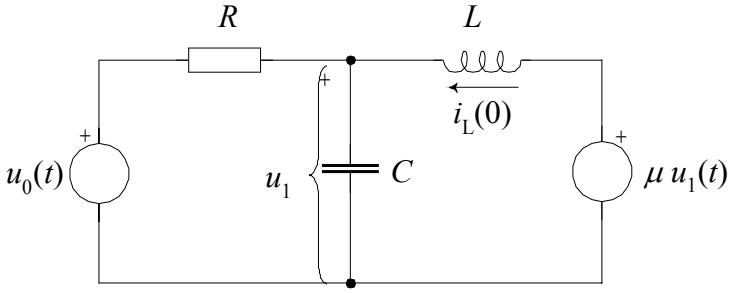


Rješenje: Primjena Laplaceove transformacije

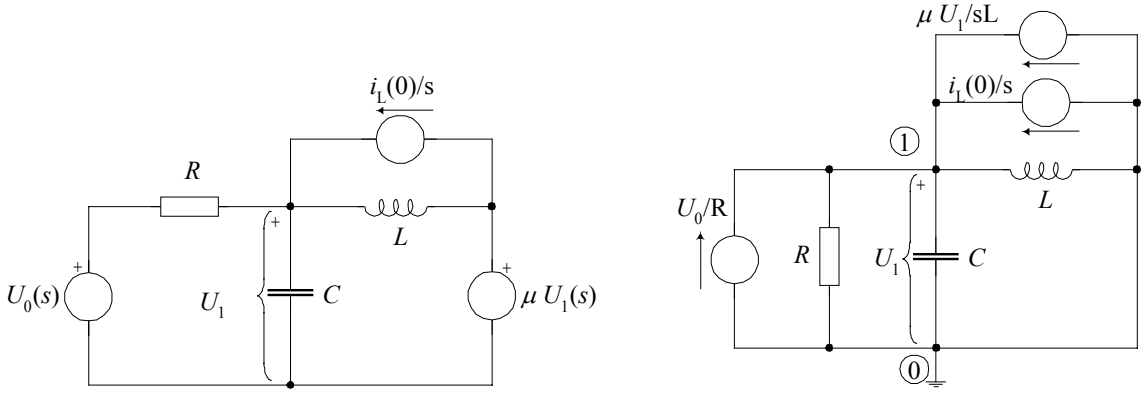


$$u_1(t) = 6\left(e^{-t} - e^{-2t}\right)S(t)$$

9. Za mrežu prikazanu slikom napisati jednadžbe čvorišta. Izračunati napon $U_1(s)$, ako je zadana pobuda $u_0(t)$= S(t), μ=2/3, početna struja kroz induktivitet $i_L(0)$=1 i normirane vrijednosti elemenata: R=1, L=1/2 i C=1/3.

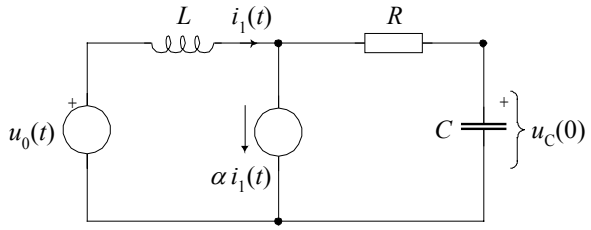


Rješenje: Primjena Laplaceove transformacije

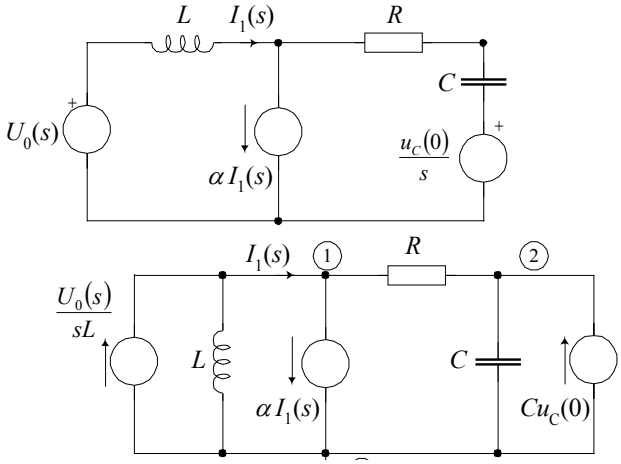


$$u_1(t) = 6\left(e^{-t} - e^{-2t}\right)S(t)$$

10. Za mrežu prikazanu slikom napisati jednadžbe čvorišta. Konačni oblik jednadžbi prikazati u formi matrične jednadžbe. Izračunati struju $I_1(s)$, ako je zadana pobuda $u_0(t)$= S(t), α=1/2, početni napon na kapacitetu $u_C(0)$=1/2 i normirane vrijednosti elemenata: R=2, L=1 i C=1.

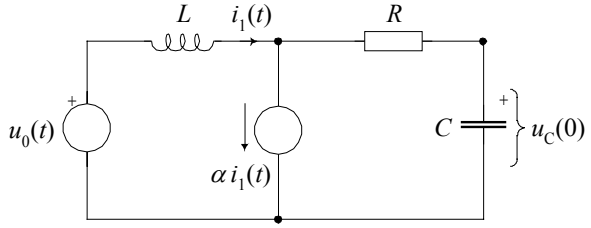


Rješenje: Primjena Laplaceove transformacije

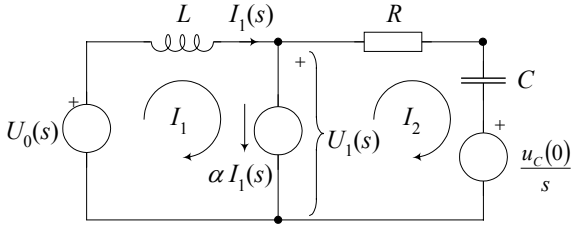


$$i_1(t) = e^{-t/2}\sin(0.5\cdot t)$$

11. Za mrežu prikazanu slikom napisati jednadžbe petlji. Izračunati struju $I_1(s)$, ako je zadana pobuda $u_0(t)$= S(t), α=1/2, početni napon na kapacitetu $u_C(0)$=1/2 i normirane vrijednosti elemenata: R=2, L=1 i C=1.

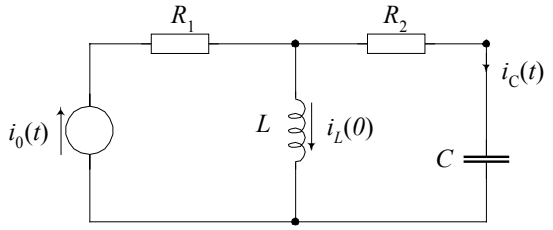


Rješenje: Primjena Laplaceove transformacije

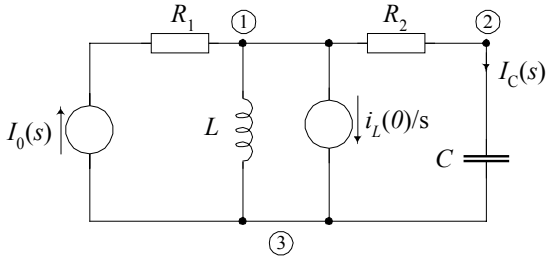


$$i_1(t) = e^{-t/2}\sin(0.5\cdot t)$$

12. Za mrežu prikazanu slikom napisati jednadžbe čvorišta. Izračunati struju $i_C(t)$, ako je zadana pobuda $i_0(t)=\delta(t)$, početna struja kroz induktivitet $i_L(0)=1$ i normirane vrijednosti elemenata: $R_1=1$ $R_2=1$, $L=1$ i $C=1$.

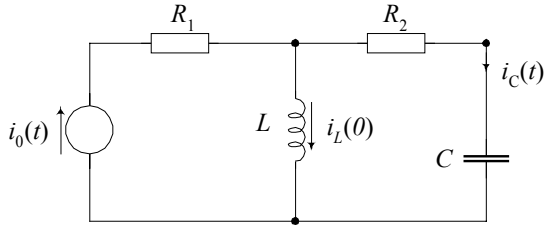


Rješenje: Primjena Laplaceove transformacije

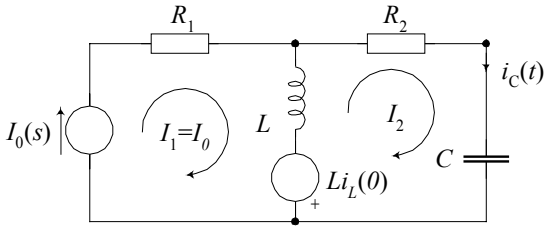


$$i_C(t)=\delta(t)-2e^{-t/2}\sin\left(\frac{\sqrt{3}}{2}\cdot t\right)S(t)$$

13. Za mrežu prikazanu slikom napisati jednadžbe petlji. Izračunati struju $i_C(t)$, ako je zadana pobuda $i_0(t)=\delta(t)$, početna struja kroz induktivitet $i_L(0)=1$ i normirane vrijednosti elemenata: $R_1=1$ $R_2=1$, $L=1$ i $C=1$.



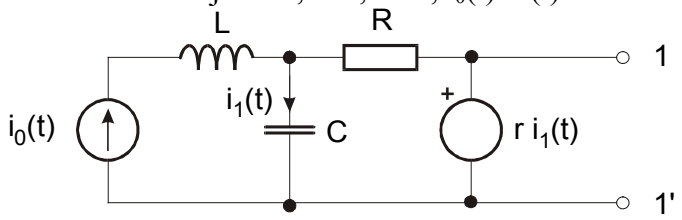
Rješenje: Primjena Laplaceove transformacije



Struja petlje 1 jednaka je struji strujnoga izvora.

$$i_C(t)=\delta(t)-2e^{-t/2}\sin\left(\frac{\sqrt{3}}{2}\cdot t\right)S(t)$$

14. Za mrežu prikazanu slikom odrediti nadomjesne parametre mreže po Teveninu $U_T(s)$ i $Z_T(s)$ na stezaljkama 1-1'. Zadano je R=2, r=1, C=1, $i_0(t)=S(t)$.

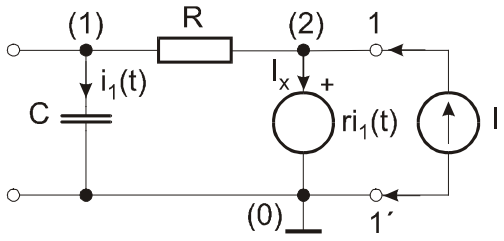


Rješenje:

a) Teveninov napon $U_T(s)$:

$$U_T(s) = I_0 \cdot \frac{rRsC}{(R-r)sC+1} = \frac{1}{s} \cdot \frac{2s}{s+1} = \frac{2}{s+1}$$

b) Teveninova impedancija $Z_T(s)$: $Z_T = \frac{U_2}{I}$

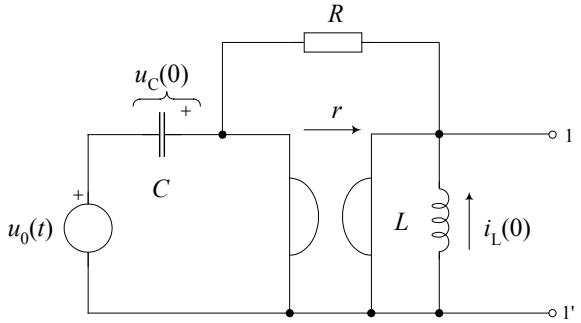


$$Z_T = \frac{U_2}{I} = 0$$

Sva struja teče kroz naponski izvor $r \cdot i_1(t)$ koji je ujedno i isključen jer je $i_1 = 0$ pa predstavlja kratki spoj(jer mu je potencijal na krajevima $r \cdot i_1(t) = 0$).

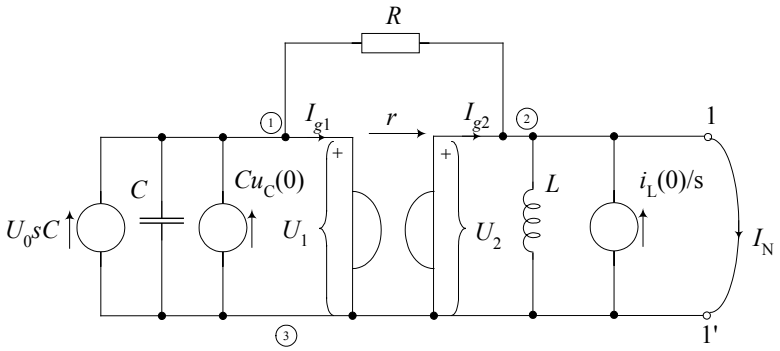
Struja I može biti proizvoljna velika, ovisno o pomoćnom strujnom izvoru. (Ne smije se u ovom slučaju staviti pomoćni naponski izvor).

15. Za krug prikazan slikom odrediti nadomjesnu shemu po Nortonu obzirom na priključnice 1-1', koristeći postupak jednadžbi čvorišta, ako je pobuda $u_0(t)= \delta(t)$. Zadane su normirane vrijednosti elemenata: R=0.5, L=1, C=1, r=1 i početni uvjeti $u_C(0)= 0.5$, $i_L(0)=1$.



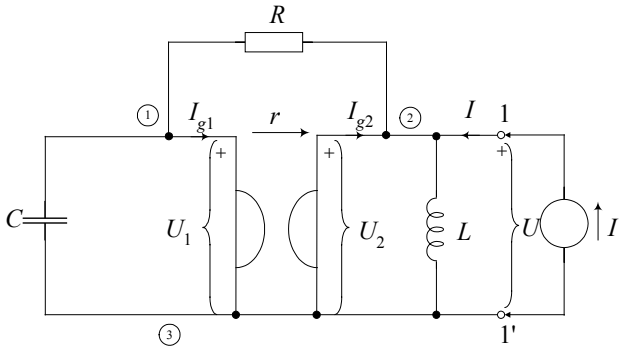
Rješenje: Primjena Laplaceove transformacije

a) Nortonova struja $I_N(s)$:



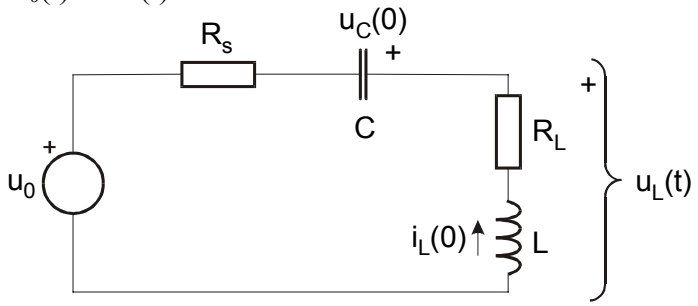
$$I_N(s)=\frac{U_0sC+Cu_C(0)}{sC+\frac{1}{R}}\left(\frac{1}{R}-\frac{1}{r}\right)+\frac{i_L(0)}{s}=\frac{s^2+1.5s+2}{s(s+2)}$$

b) Nortonova admitancija $Y_N(s)$:

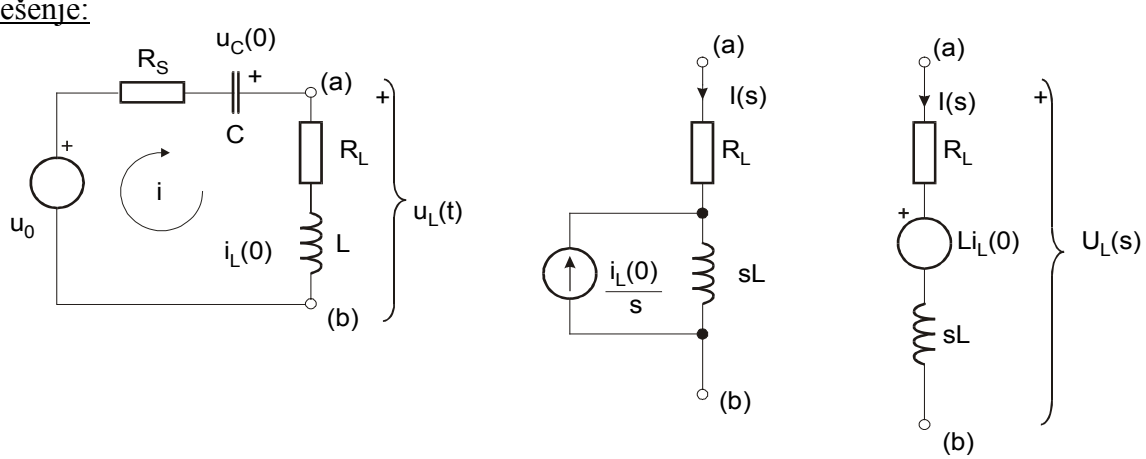


$$Y_N(s)=\frac{I}{U}=\frac{R+sr^2C}{r^2(sCR+1)}+\frac{1}{sL}=\frac{s^2+s+1}{s(0.5s+1)}$$

16. Odrediti odziv $u_L(t)$ mreže prikazane slikom ako je zadano: R_s=R_L=1, L=1, C=1, $i_L(0)$=1, $u_C(0)$=1 i poticaj: u_0(t)=e^{-t} $S(t)$.

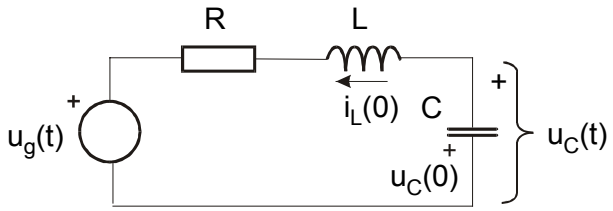


Rješenje:

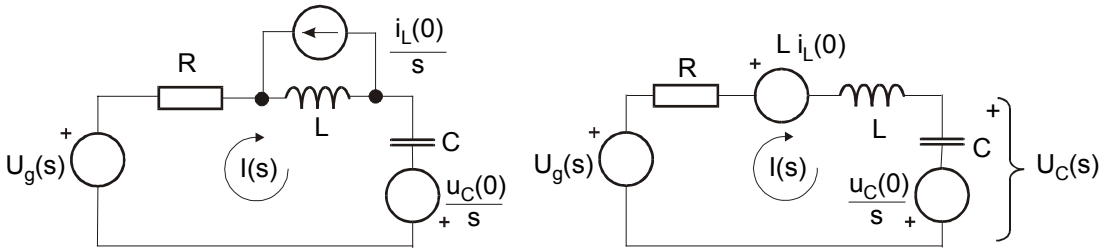


Rješenje: $u_L(t)=(3-t)\cdot e^{-t}\cdot S(t)$

17. Za mrežu na slici odrediti napon na kapacitetu $u_C(t)$. Zadano je: R=4, C=1/2, L=2, $i_L(0)$=1.2A, $u_C(0)$=2.6V, $u_g(t)=S(t)$.

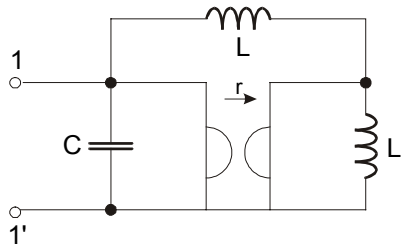


Rješenje: Primjenom Laplaceove transformacije:

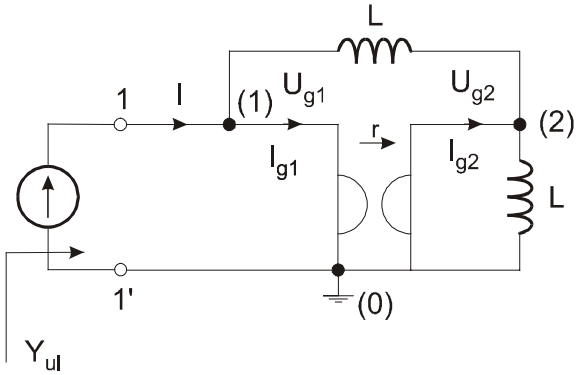


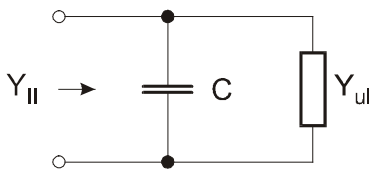
$$u_C(t) = (-1.6 \cdot e^{-t} - 4t \cdot e^{-t}) \cdot S(t) - S(t)$$

18. Za prikazani dvopol odrediti admitanciju na priključnicama 1-1'. Zadano je L=1, C=1, r=1.



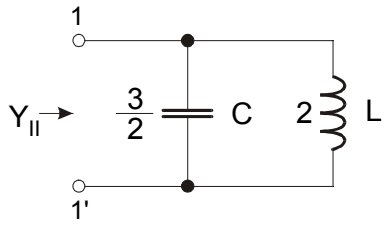
Rješenje:



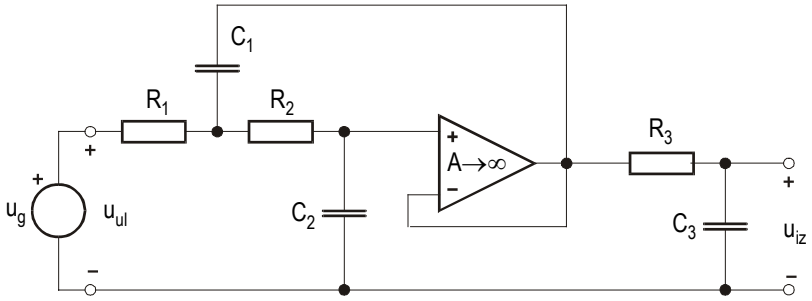


$$Y_{II} = \frac{3s^2+1}{2s} = \frac{3}{2}s + \frac{1}{2s}$$

Konačno dobiveni dvopol ima oblik:



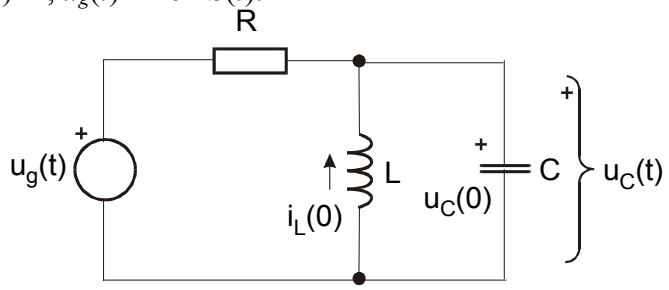
19. Za mrežu prikazanu slikom odrediti odziv napona $U_{iz}(s)$, ako je zadan poticaj $U_{ul}(s)=1$. Zadano je $R_1=1$, $R_2=1$, $R_3=1$, $C_1=2$, $C_2=1/2$, $C_3=1$.



Rješenje:

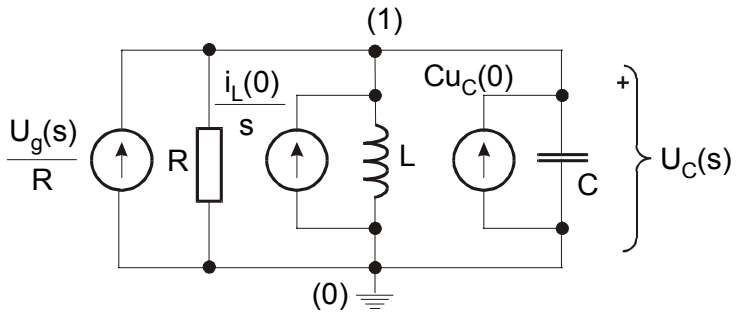
$$U_{iz}(s)=\frac{1}{(s+1)(s^2+s+1)}$$

20. Odrediti i skicirati valni oblik napona $u_C(t)$ u prikazanoj mreži ako je zadano: $R=2$, $C=0.5$, $L=1$, $u_C(0)=2$, $i_L(0)=4$, $u_g(t)= 2\,e^{-t}\,S(t)$.



Rješenje:

Primjenom Laplaceove transformacije i transformacija izvora:



$$u_C(t)=e^{-\frac{t}{2}}\left(3\cos\frac{\sqrt{7}}{2}t+\frac{17}{\sqrt{7}}\sin\frac{\sqrt{7}}{2}t\right)\cdot S(t)-e^{-t}\cdot S(t)$$