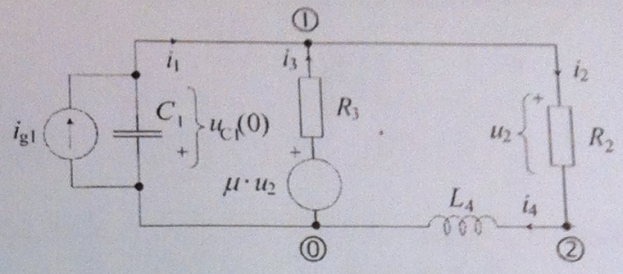
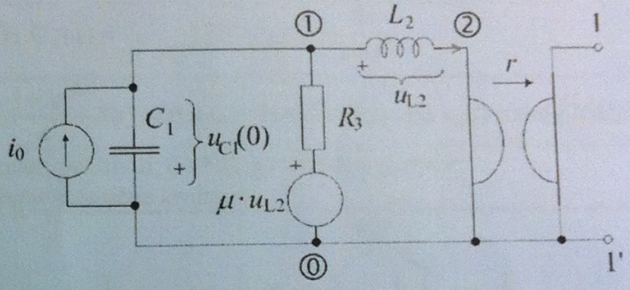
MEĐUISPIT IZ ELEKTRIČNIH KRUGOVA 2011-2012

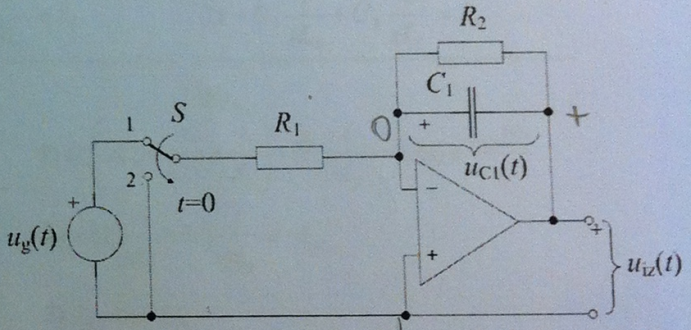
1. Za električni krug na slici i pridruženim orijentacijama grana te čvorovima zadane su normalizirane vrijednosti elemenata C_1=1, R_2=1, R_3=1, L_4=1 te μ=2, $u_{C1}(0)$=1, $i_{g1}(t)$=$S(t)$. Koristeći KZS i KZN te oznake grana i čvorova prema slici, napisati: a) Jednadžbe KZS i KZN; b) Naponsko-strujne jednadžbe za grane; c) Napon na otporu R_2 $U_2(s)$; d) Napon na otporu R_2 $u_2(t)$; e) Da li je električni krug stabilan? Zašto?



2. Za električni krug na slici zadane su normalizirane vrijednosti elemenata C_1=1, L_2=1, R_3=1 te μ=2, r=1, $u_{C1}(0)$=1, $i_0(t)$=$S(t)$. Odrediti nadomjesne parametre mreže po Northonu s obzirom na polove 1–1'. Koristiti metodu napona čvorišta (čvorište ⓪ je referentno). U zadatku je potrebno: a) Nacrtati sklop za izračunavanje Nortonove struje, postaviti jednadžbe napona za čvorišta ① i ②; b) Odrediti Nortonovu struju $I_N(s)$; c) Nacrtati sklop za izračunavanje Nortonove admitancije, postaviti jednadžbe napona za čvorišta ① i ②; d) Odrediti Nortonovu admitanciju $Y_N(s)$. e) Da li je električni krug recipročan? Zašto?

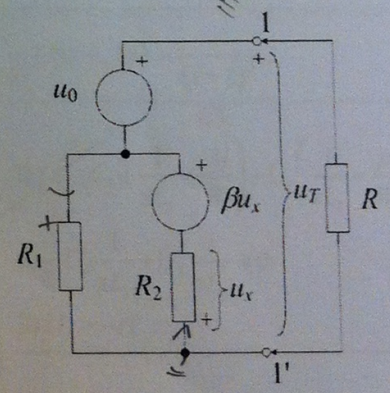


3. Za električni krug prikazan slikom se u trenutku t=0 prebaci sklopka S iz položaja 1 u 2 uzrokujući prijelaznu pojavu. Zadane su normalizirane vrijednosti elemenata: R_1=1, R_2=1/2, C_1=1, $u_g(t)$=10 V; $-\infty<t<\infty$ (istosmjerni napon-baterija). Odrediti za t<0: a) valni oblik napona na kapacitetu $u_{C1}(t)$; b) početni napon $u_{C1}(0)$. Odrediti za $t\geq0$: c) napon na izlazu operacijskog pojačala $U_{iz}(s)$; d) valni oblika napona $u_{iz}(t)$. e) Ako je R_2=2 odrediti valni oblik napona $u_{iz}(t)$ za $-\infty<t<\infty$.

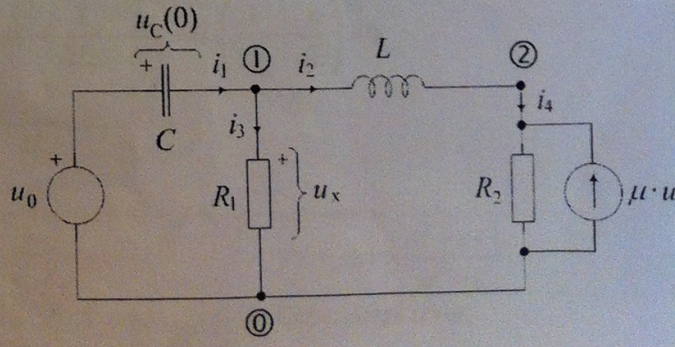


4. Za krug prikazan slikom isključiti otpor R i obzirom na priključnice 1–1' odrediti:
   a) Teveninov napon u_T;
   b) Teveninov otpor R_T;
   c) iznos konstante β za koji je R_T=R;
   d) napon u_x uz uključen otpor R [β iz zadatka c)].
   e) Za koji iznos konstante β je R_T=∞?

Zadano je: pobuda u_0=2 V i vrijednosti elemenata R_1=R_2=2 Ω, R=4 Ω.



5. Za električni krug prikazan slikom i pridruženim orijentacijama grana te čvorovima (grane stabla: 1, 2) treba odrediti temeljni sustav jednadžbi petlji primjenom grafova. Napisati: a) spojnu matricu **S**, b) matricu impedancija grana $\mathbf{Z}_b$, c) vektor početnih uvjeta i nezavisnih izvora grana $\mathbf{U}_{0b}$, d) matricu impedancija petlji $\mathbf{Z}_p$ i e) vektor početnih uvjeta i nezavisnih izvora petlji $\mathbf{U}_{0p}$.



MEĐUISPIT IZ ELEKTRIČNIH KRUGOVA - Ponuđeni odgovori

(svako pitanje je 1 bod, netočno zaokruženo je –0.25 bodova)

Pitanja: (pitanju **1** odgovara potpitanje je u tekstu označeno sa (1.a)) Zaokružiti samo jedan odgovor (A–E)!

1 (1.a)

A)
1) $-I_1+I_2=0$
2) $-I_2+I_4-I_3=0$
3) $U_1-U_3+U_4=0$
4) $U_2+U_3=0$

B)
1) $-I_1+I_2+I_3=0$
2) $-I_2+I_4=0$
3) $U_1+U_3=0$
4) $U_2+U_3+U_4=0$

C)
1) $-I_1=I_2$
2) $-I_2=I_4-I_3$
3) $U_1-U_3=U_4$
4) $U_2+U_3=0$

D)
1) $-I_1=I_4+I_2$
2) $-I_2=I_4-I_3$
3) $U_1-U_3+U_4=0$
4) $U_2+U_3+U_4=0$

E)
1) $-I_1+I_2-I_3=0$
2) $-I_2+I_4=0$
3) $U_1-U_3=0$
4) $U_2+U_3+U_4=0$

2 (1.b)

A)
1) $U_1=\frac{I_1-I_{g1}}{sC_1}+\frac{u_{C1}(0)}{s}$
2) $U_2=R_2\cdot I_2$
3) $U_3=R_3\cdot I_3-\mu R_2 I_2$
4) $U_4=sL_4\cdot I_4$

B)
1) $U_1=\frac{I_1-I_{g1}}{sC_1}-\frac{u_{C1}(0)}{s}$
2) $U_2=R_2\cdot I_2$
3) $U_3=R_3\cdot I_3+\mu R_2 I_2$
4) $U_4=sL_4\cdot I_4$

C)
1) $U_1=sC_1(I_1-I_{g1})+C_1u_{C1}(0)$
2) $U_2=R_2\cdot I_2$
3) $U_3=R_3\cdot I_3+\mu R_2 I_2$
4) $U_4=sL_4\cdot I_4$

D)
1) $U_1=\frac{I_{g1}-I_1}{sC_1}\frac{u_{C1}(0)}{s}$
2) $U_2=R_2\cdot I_2$
3) $U_3=R_3\cdot(1-\mu)I_3$
4) $U_4=sL_4\cdot I_4$

E)
1) $U_1=sC_1(I_1-I_{g1})+C_1u_{C1}(0)$
2) $U_2=1/R_2\cdot I_2$
3) $U_3=-R_3\cdot I_3+\mu R_2 I_2$
4) $U_4=-sL_4\cdot I_4$

3 (1.c) A) $U_2(s)=\frac{2-s}{s^2-2}$; B) $U_2(s)=\frac{1-s}{s^2(s-2)}$; C) $U_2(s)=\frac{1-s}{s^2(2+s)}$; D) $U_2(s)=\frac{s}{s^2+2}$; E) $U_2(s)=\frac{5s}{2+s^2}$.

4 (1.d) A) $u_2(t)=-\frac{2t-1+e^{2t}}{4}S(t)$; B) $u_2(t)=\frac{2t-3+3e^{-2t}}{4}S(t)$; C) $u_2(t)=\frac{-1+3e^{-2t}}{4}S(t)$; D) $u_2(t)=\cos(\sqrt{2}t)S(t)$; E) $u_2(t)=\sin(\sqrt{2}t)S(t)$.

5 (1.e) A) NE, jer ima dvostruki pol u ishodištu; B) DA, jer su mu svi elementi pozitivni; C) NE, jer ima ovisni izvor; D) NE, jer ima pol izvan jedinične kružnice; E) DA, jer ima pol unutar jedinične kružnice.

6 (2.a)

A)
1) $U_1\left(sC_1+\frac{1}{sL_2}+\frac{1}{R_3}\right)-U_2\frac{1}{sL_2}=I_0(s)-C_1u_{C1}(0)$
2) $-U_1\frac{1}{sL_2}+U_2\frac{1}{sL_2}=0$
3) $I_N=-\frac{1}{r}U_1$

B)
1) $U_1\left(sC_1+\frac{1}{sL_2}+\frac{1}{R_3}\right)+U_2\frac{1}{sL_2}=I_0(s)-C_1u_{C1}(0)$
2) $-U_1\frac{1}{sL_2}+U_2\frac{1}{sL_2}=I_N$

C)
1) $U_1\left(sC_1+\frac{1}{sL_2}+\frac{1}{R_3}\right)+U_2\frac{1}{sL_2}=I_0(s)-u_{C1}(0)/s$
2) $-U_1\frac{1}{sL_2}+U_2\frac{1}{sL_2}=I_N$

D)
1) $U_1\left(sC_1+\frac{1}{sL_2}+\frac{1}{R_3}\right)+U_2\frac{1}{sL_2}=I_0(s)+C_1u_{C1}(0)$
2) $-U_1\frac{1}{sL_2}+U_2\frac{1}{sL_2}=I_{g1}$
3) $I_N=\frac{1}{r}U_1$

E)
1) $U_1\left(sC_1+\frac{1}{sL_2}+\frac{1}{R_3}\right)+U_2\frac{1}{sL_2}=I_0(s)+\frac{u_{C1}(0)}{s}$
2) $-U_1\frac{1}{sL_2}+U_2\frac{1}{sL_2}=-I_{g1}$
3) $I_N=-\frac{1}{r}U_1$

7 (2.b) A) $I_N(s)=\frac{s+1}{s(s+1)}$; B) $I_N(s)=\frac{s-1/s}{s+1}$; C) $I_N(s)=\frac{s^2+1}{s+1}$; D) $I_N(s)=\frac{s-1}{s(s+1)}$; E) $I_N(s)=\frac{s}{(s+1)^2}$.

8 (2.c)

A)
1) $U_1\left(sC_1+\frac{1}{sL_2}\right)+U_2\left(\frac{1}{sL_2}-\frac{\mu}{R_3}\right)=0$
2) $-U_1\frac{1}{sL_2}-U_2\frac{1}{sL_2}=0$
3) $U_2=-rI$

B)
1) $U_1\left(sC_1+\frac{1}{sL_2}+\frac{1-\mu}{R_3}\right)-U_2\left(\frac{1}{sL_2}-\frac{\mu}{R_3}\right)=0$
2) $-U_1\frac{1}{sL_2}+U_2\frac{1}{sL_2}=\frac{1}{r}U$
3) $U_2=rI$

C)
1) $U_1\left(sC_1+\frac{1}{sL_2}+\frac{1}{R_3}\right)+U_2\left(\frac{1}{sL_2}-\frac{\mu}{R_3}\right)=0$
2) $-U_1\frac{1}{sL_2}+U_2\frac{1}{sL_2}=0$
3) $U_2=-rI$

D)
1) $U_1\left(sC_1+\frac{1}{sL_2}+\frac{1-\mu}{R_3}\right)-U_2\left(\frac{1}{sL_2}+\frac{\mu}{R_3}\right)=0$
2) $U_1\frac{1}{sL_2}+U_2\frac{1}{sL_2}=\frac{U}{r}$
3) $U_2=rI$

E)
1) $U_1\left(sC_1+\frac{1}{sL_2}-\frac{\mu}{R_3}\right)-U_2\left(\frac{1}{sL_2}-\frac{\mu}{R_3}\right)=0$
2) $-U_1\frac{1}{sL_2}+U_2\frac{1}{sL_2}=\frac{U}{r}$
3) $U_2=-rI$

9 (2.d) A) $Y_N(s)=\frac{s^2+s+1}{s+1}$; B) $Y_N(s)=\frac{s+1/s}{s+1}$; C) $Y_N(s)=\frac{s^2+s+1}{s^2+s}$; D) $Y_N(s)=\frac{s^2-s+1}{s+1}$; E) $Y_N(s)=\frac{s^2-s+1}{s^2+s}$.

10 (2.e) A) NE, jer sadrži ovisni izvor i girator; B) DA, jer ima početni uvjet; C) NE, jer ima neovisni strujni izvor; D) DA, jer ne sadrži idealni transformator; E) DA, jer ima pol u lijevoj poluravnini.

11 (3.a) A) $u_{C1}(t) = 20\,\mathrm{V};\ t<0$; B) $u_{C1}(t) = -10e^{-t}\,\mathrm{V};\ t<0$; C) $u_{C1}(t) = 5\,\mathrm{V};\ t<0$; D) $u_{C1}(t) = 10e^{-2t}\,\mathrm{V};\ t<0$; E) $u_{C1}(t) = -5\,\mathrm{V};\ t<0$.

12 (3.b) A) $u_{C1}(0) = -5\,\mathrm{V}$; B) $u_{C1}(0) = 5\,\mathrm{V}$; C) $u_{C1}(0) = 0$; D) $u_{C1}(0) = 20\,\mathrm{V}$; E) $u_{C1}(0) = 10\,\mathrm{V}$.

13 (3.c) A) $U_{iz}(s) = \dfrac{-5}{s+2}$; B) $U_{iz}(s) = \dfrac{1}{s+2}$; C) $U_{iz}(s) = \dfrac{-1}{s+1/2}$; D) $U_{iz}(s) = \dfrac{10}{s-1/2}$; E) $U_{iz}(s) = \dfrac{10}{s-2}$.

14 (3.d) A) $u_{iz}(t) = e^{-2t}\cdot S(t)$; B) $u_{iz}(t) = -5e^{-2t}\cdot S(t)$; C) $u_{iz}(t) = -e^{-1/2t}\cdot S(t)$; D) $u_{iz}(t) = 10e^{2t}\cdot S(t)$; E) $u_{iz}(t) = 10e^{1/2t}\cdot S(t)$.

15 (3.e) A) $u_{iz}(t) = \begin{cases} 10, & t<0 \\ 10e^{-\frac{t}{2}}, & t\geq 0 \end{cases}$; B) $u_{iz}(t) = \begin{cases} 10, & t<0 \\ 10e^{2t}, & t\geq 0 \end{cases}$; C) $u_{iz}(t) = \begin{cases} -20, & t<0 \\ -20e^{-2t}, & t\geq 0 \end{cases}$; D) $u_{iz}(t) = \begin{cases} -5, & t<0 \\ -5e^{\frac{t}{2}}, & t\geq 0 \end{cases}$; E) $u_{iz}(t) = \begin{cases} -20, & t<0 \\ -20e^{\frac{t}{2}}, & t\geq 0 \end{cases}$.

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16 (4.a) A) $u_T(t) = -2\mathrm{V}$; B) $u_T(t) = 2\mathrm{V}$; C) $u_T(t) = 0\mathrm{V}$; D) $u_T(t) = 1\mathrm{V}$; E) $u_T(t) = -1\mathrm{V}$.

17 (4.b) A) $R_T = \dfrac{R_1R_2}{R_1(1-\beta)+R_2}$; B) $R_T = \dfrac{R_1R_2(1+\beta)}{R_1(1+\beta)+R_2}$; C) $R_T = \dfrac{R_1R_2(1-\beta)}{R_2(1-\beta)+R_1}$; D) $R_T = \dfrac{R_1R_2(\beta-1)}{R_2(\beta-1)+R_1}$; E) $R_T = \dfrac{R_1R_2(1+\beta)}{R_2(1+\beta)+R_1}$.

18 (4.c) A) $\beta = 3$; B) $\beta = 2$; C) $\beta = 1$; D) $\beta = 4$; E) $\beta = 5$.

19 (4.d) A) $u_x = -\dfrac{1}{2}V$; B) $u_x = \dfrac{1}{13}V$; C) $u_x = \dfrac{4}{13}V$; D) $u_x = \dfrac{4}{9}V$; E) $u_x = -\dfrac{4}{9}V$.

20 (4.e) (4.e) A) $\beta = 1$; B) $\beta = 2$; C) $\beta = 3$; D) $\beta = 4$; E) $\beta = 5$.

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21 (5.a) A) $\mathbf{S} = \begin{bmatrix} -1 & 1 & 1 & 0 \\ 0 & -1 & 0 & 1 \end{bmatrix}$; B) $\mathbf{S} = \begin{bmatrix} -1 & 0 & -1 & 0 \\ -1 & -1 & 0 & -1 \end{bmatrix}$; C) $\mathbf{S} = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 \end{bmatrix}$; D) $\mathbf{S} = \begin{bmatrix} 1 & -1 & -1 & 0 \\ 0 & 1 & 0 & -1 \end{bmatrix}$; E) $\mathbf{S} = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & -1 & 1 \end{bmatrix}$.

22 (5.b) A) $\mathbf{Z}_b = \begin{bmatrix} \frac{1}{sC} & 0 & 0 & 0 \\ 0 & sL & 0 & 0 \\ 0 & 0 & R_1 & 0 \\ 0 & -\mu sLR_2 & 0 & R_2 \end{bmatrix}$; B) $\mathbf{Z}_b = \begin{bmatrix} \frac{1}{sC} & 0 & 0 & 0 \\ 0 & sL & 0 & 0 \\ 0 & 0 & R_1 & 0 \\ 0 & 0 & \mu R_1R_2 & R_2 \end{bmatrix}$; C) $\mathbf{Z}_b = \begin{bmatrix} sC & 0 & 0 & 0 \\ 0 & \frac{1}{sL} & 0 & 0 \\ 0 & 0 & \frac{1}{R_1} & 0 \\ 0 & 0 & -\mu R_2 & \frac{1}{R_2} \end{bmatrix}$;

D) $\mathbf{Z}_b = \begin{bmatrix} \frac{1}{sC} & 0 & 0 & 0 \\ 0 & sL & 0 & 0 \\ 0 & 0 & R_1 & 0 \\ 0 & 0 & 0 & R_2 \end{bmatrix}$; E) $\mathbf{Z}_b = \begin{bmatrix} \frac{1}{sC} & 0 & 0 & 0 \\ 0 & sL & 0 & 0 \\ 0 & 0 & R_1 & 0 \\ 0 & 0 & -\mu R_1R_2 & R_2 \end{bmatrix}$.

23 (5.c) A) $\mathbf{U}_{0b} = \begin{bmatrix} \frac{u_C(0)}{s} + U_0(s) \\ 0 \\ 0 \\ 0 \end{bmatrix}$; B) $\mathbf{U}_{0b} = \begin{bmatrix} -\frac{u_C(0)}{s} + U_0(s) \\ 0 \\ 0 \\ 0 \end{bmatrix}$; C) $\mathbf{U}_{0b} = \begin{bmatrix} \frac{u_C(0)}{s} - U_0(s) \\ 0 \\ 0 \\ 0 \end{bmatrix}$; D) $\mathbf{U}_{0b} = \begin{bmatrix} -U_0(s) \\ 0 \\ 0 \\ 0 \end{bmatrix}$; E) $\mathbf{U}_{0b} = \begin{bmatrix} -\frac{u_C(0)}{s} - U_0(s) \\ 0 \\ 0 \\ 0 \end{bmatrix}$.

24 (5.d) A) $\mathbf{Z}_p = \begin{bmatrix} \frac{1}{sC} + R_1 & \frac{1}{sC} \\ \frac{1}{sC} + \mu R_1R_2 & \frac{1}{sC} + sL + R_2 \end{bmatrix}$; B) $\mathbf{Z}_p = \begin{bmatrix} \frac{1}{sC} + R_1 & \frac{1}{sC} \\ \frac{1}{sC} + \mu R_1R_2 & \frac{1}{sC} + sL + \mu sLR_2 + R_2 \end{bmatrix}$; C) $\mathbf{Z}_p = \begin{bmatrix} \frac{1}{sC} + sL + R_1 & -sL \\ -sL + \mu R_1R_2 & sL + R_2 \end{bmatrix}$;

D) $\mathbf{Z}_p = \begin{bmatrix} -\frac{1}{sC} + R_1 & \frac{1}{sC} \\ \frac{1}{sC} & \frac{1}{sC} + sL + R_2 \end{bmatrix}$; E) $\mathbf{Z}_p = \begin{bmatrix} \frac{1}{sC} + R_1 & \frac{1}{sC} \\ \frac{1}{sC} - \mu R_1R_2 & \frac{1}{sC} + sL + R_2 \end{bmatrix}$.

25 (5.e) A) $\mathbf{U}_{0p} = \begin{bmatrix} U_0(s) \\ U_0(s) \end{bmatrix}$; B) $\mathbf{U}_{0p} = \begin{bmatrix} -\frac{u_C(0)}{s} - U_0(s) \\ -\frac{u_C(0)}{s} - U_0(s) \end{bmatrix}$; C) $\mathbf{U}_{0p} = \begin{bmatrix} \frac{u_C(0)}{s} + U_0(s) \\ \frac{u_C(0)}{s} + U_0(s) \end{bmatrix}$; D) $\mathbf{U}_{0p} = \begin{bmatrix} U_0(s) - \frac{u_C(0)}{s} \\ U_0(s) - \frac{u_C(0)}{s} \end{bmatrix}$; E) $\mathbf{U}_{0p} = \begin{bmatrix} \frac{u_C(0)}{s} - U_0(s) \\ \frac{u_C(0)}{s} - U_0(s) \end{bmatrix}$.

- OVAJ OBRAZAC SE **MORA** PREDATI ZAJEDNO S OBRASCEM ZA ZACRNJIVANJE -