

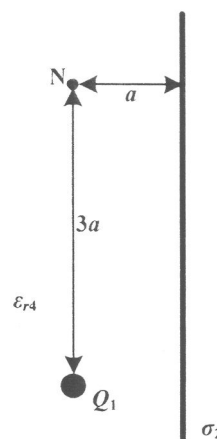
PRVI KOLOKVIJUM IZ ELEKTROTEHNIKE

16. april 2014.

GRUPA 4

1. Tačkasto naelektrisanje $Q_1 = Q > 0$ i veoma velika, ravnomerno naelektrisana površ, površinske gustine naelektrisanja $\sigma_2 = -\sigma < 0$ nalaze se u dielektriku relativne dielektrične konstante ϵ_{r4} kao na Slici 1.

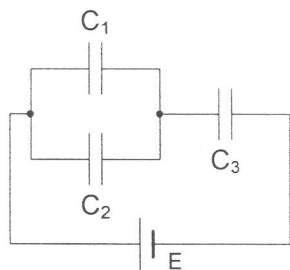
- a) Odrediti i **skicirati** vektor elektičnog polja u tački N. (3 poena)
 b) Odrediti i **skicirati** vektor sile kojom površ deluje na tačkasto naelektrisanje. (2 poena)



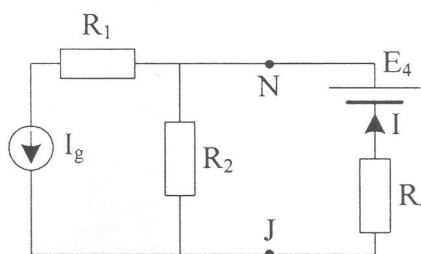
Slika 1

2. Na Slici 2 je prikazana mreža sa kondenzatorima koji su pre povezivanja bili neopterećeni. Odrediti količinu naelektrisanja i napon na svakom kondenzatoru, kao i energiju elektrostatičkog polja kondenzatora C_1 . Obavezno naznačiti referentne smerove naelektrisanja i napona svih kondenzatora. Poznato je: $C_1 = 1\mu\text{F}$, $C_2 = 4\mu\text{F}$, $C_3 = 10\mu\text{F}$, $E = 60\text{V}$.

(5 poena)



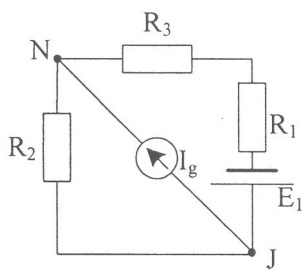
Slika 2



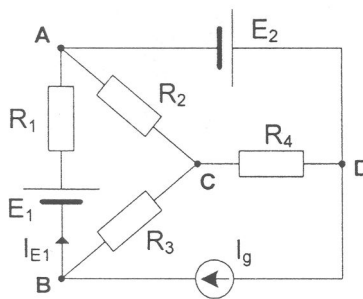
Slika 3

3. U kolu prikazanom na Slici 3, primenom Tevenenove teoreme odrediti intenzitet struje I. Poznato je: $E_4 = 15\text{V}$, $I_g = 2\text{A}$, $R_1 = 10\Omega$, $R_2 = 20\Omega$, $R_4 = 35\Omega$. (5 poena)

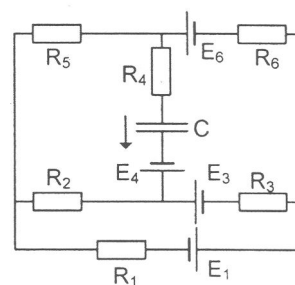
4. Primenom metode superpozicije naći napon U_{NJ} . Poznato je: $R_1 = 1.5\Omega$, $R_2 = 1\Omega$, $R_3 = 2.5\Omega$, $E_1 = 10\text{V}$, $I_g = 5\text{A}$. (5 poena)



Slika 4



Slika 5

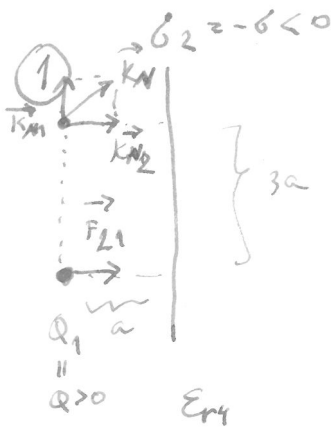


Slika 6

5. U kolu na Slici 5, primenom metode konturnih struja ili napona između čvorova odrediti struju I_{E1} i napon U_{BD} . Poznato je: $E_1 = 30\text{V}$, $E_2 = 20\text{V}$, $I_g = 1\text{A}$, $R_1 = R_2 = R_3 = R_4 = 10\Omega$. (5 poena)

6. U kolu prikazanom na Slici 6 uspostavljeno je stacionarno stanje. Odrediti količinu naelektrisanja kondenzatora u smeru naznačenom na slici. Poznato je: $R_1 = R_2 = R_3 = R_4 = R_5 = R_6 = 20\Omega$, $E_1 = 120\text{V}$, $E_3 = 60\text{V}$, $E_4 = 10\text{V}$, $E_6 = 100\text{V}$, $C = 15\mu\text{F}$. (5 poena)

Izrada kolokvijuma traje 90 minuta. Na vežbanci napisati broj grupe zadataka. Papir sa tekstom zadataka predaje se u vežbanci tj. ne sme se izneti.



$$a) \vec{K}_{N1} = \frac{Q_1}{4\pi\epsilon_0\epsilon_r 4 (3a)^2} \vec{j} = \frac{Q}{36\pi\epsilon_0\epsilon_r 4 a^2} \vec{j}$$

$$\vec{K}_{N2} = \frac{\sigma_2}{2\epsilon_0\epsilon_r} (-\vec{i}) = \frac{\sigma}{2\epsilon_0\epsilon_r} \vec{i}$$

$$\vec{K}_N = \vec{K}_{N1} + \vec{K}_{N2} = \frac{\sigma}{2\epsilon_0\epsilon_r} \vec{i} + \frac{Q}{36\pi\epsilon_0\epsilon_r 4 a^2} \vec{j}$$

$$b) \vec{F}_{21} = \vec{K}_2 \cdot Q_1 = \frac{\sigma Q}{2\epsilon_0\epsilon_r} \vec{i}$$

2) Microvi!
 $Q_i \rightarrow$
 $+ U_i -$

$$C_{12} = 5 \mu F$$

$$C_{123} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_3}} = \frac{1}{\frac{1}{5} + \frac{1}{10}} = \frac{10}{3} \mu F$$

$$Q_{123} = C_{123} E = \frac{10}{3} \cdot 60 = 200 \mu C$$

$$W_1 = \frac{1}{2} Q_1 U_1 = \frac{1}{2} 40 \mu C \cdot 40$$

$$W_1 = 800 \mu J$$

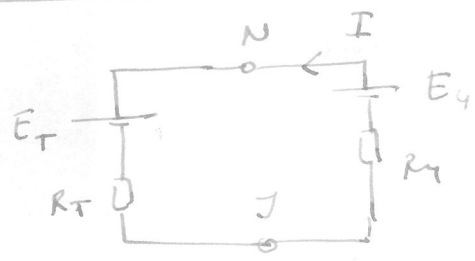
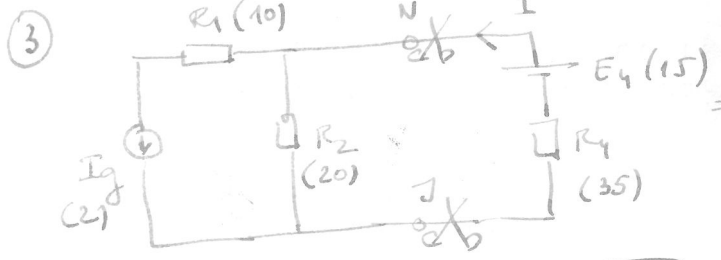
$$Q_3 = Q_{123} = 200 \mu C$$

$$U_3 = \frac{Q_3}{C_3} = 20 V$$

$$U_{23} = E - U_3 = 40 V = U_2 = U_4$$

$$Q_2 = C_2 U_2 = 4 \cdot 40 = 160 \mu C$$

$$Q_1 = C_1 U_1 = 1 \cdot 40 = 40 \mu C$$

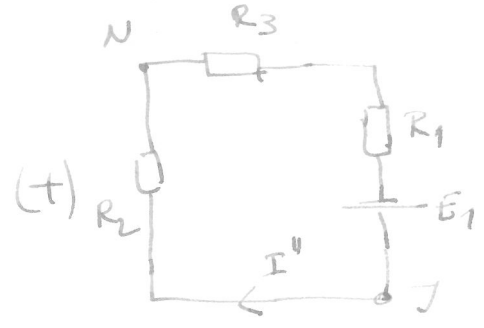
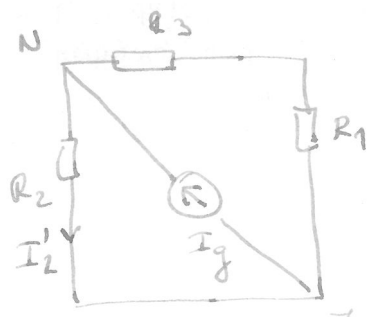
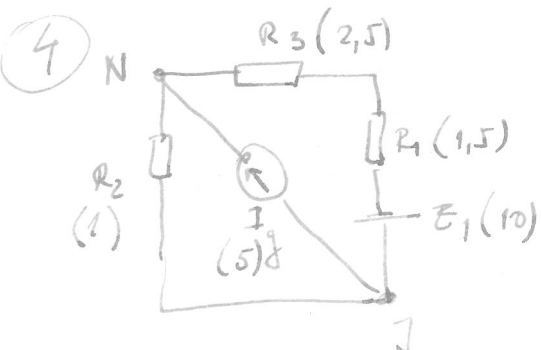


$$E_T = U_{NJ} = -R_2 I_g = -40 V$$

$$R_T = R_2 = 20 \Omega$$

$$I = \frac{E_4 - E_T}{R_T + R_4}$$

$$I = \frac{15 + 40}{35 + 20} = 1 A$$



$$U_{NJ} = U_{N1} + U_{N3}$$

$$U_{NJ} = 4 - 2V = 2V$$

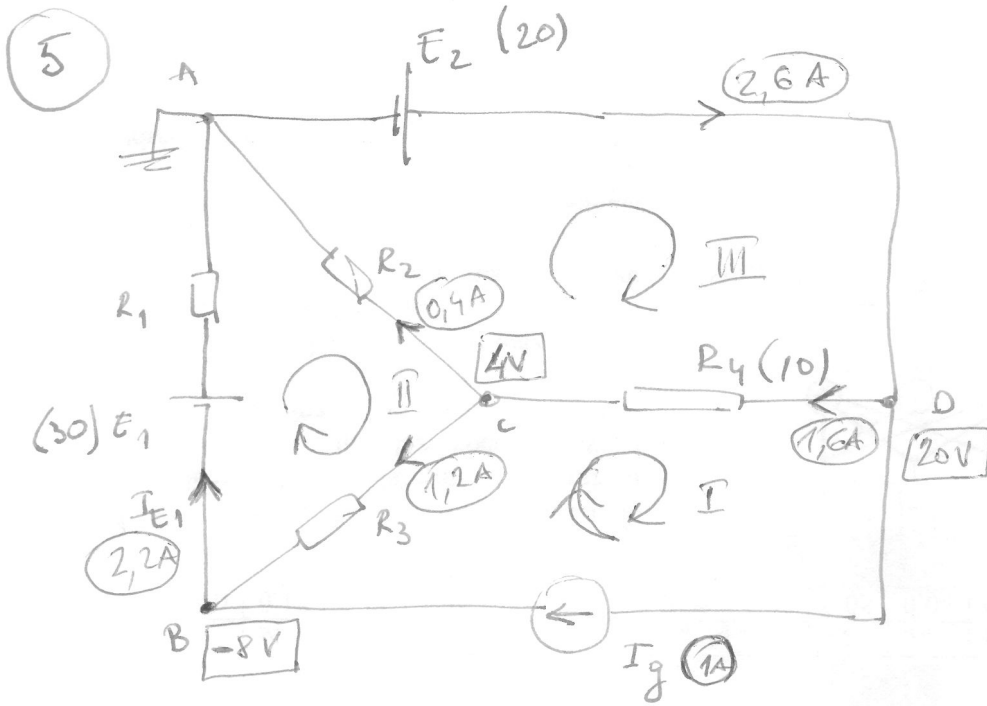
$$I_2' = \frac{R_1 + R_3}{R_1 R_2 + R_3} I_g = \frac{4}{5} \cdot 5 = 4 A$$

$$U_{NJ} = R_2 I_2' = 4V$$

$$I'' = \frac{E_1}{R_1 + R_2 + R_3} = \frac{10}{5} = 2 A$$

$$U_{NJ}'' = -R_2 I''$$

$$U_{NJ}'' = -2V$$



$$I_{E1} = I_{II} = 2,2A$$

$$U_{BD} = -E_1 - E_2 + R_1 I_{E1}$$

$$U_{BD} = -30 - 20 + 22$$

$$U_{BD} = -28V$$

$$I_I = I_g = 1A$$

$$-R_3 I_I + (R_1 + R_2 + R_3) I_{II} - R_2 I_{III} = E_1$$

$$-R_4 I_I - R_2 I_{II} + (R_2 + R_4) I_{III} = E_2$$

$$30 I_{II} - 10 I_{III} = 30 + 10 = 40$$

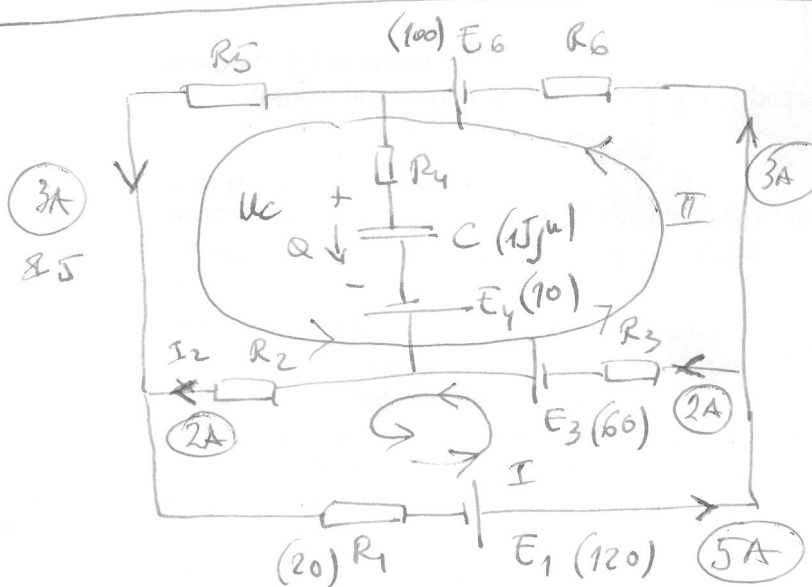
$$-10 I_{II} + 20 I_{III} = 20 + 10 = 30$$

$$50 I_{II} = 110$$

$$I_{II} = \frac{11}{5} A = 2,2A$$

$$I_{III} = \frac{30 + 22}{20} = \frac{52}{20} = 2,6A$$

$$I_{III} = 2,6A$$



$$(R_1 + R_2 + R_3) I_I + (R_2 + R_3) I_{II} = E_1 + E_3$$

$$-(R_2 + R_3) I_I + (R_2 + R_3 + R_5 + R_6) I_{II} = E_6 - E_3$$

$$60 I_I - 40 I_{II} = 180$$

$$-40 I_I + 80 I_{II} = 40$$

$$40 I_I = 200 \Rightarrow I_I = \frac{200}{40} = 5A$$

$$I_{II} = \frac{40 + 40 \cdot 5}{80} \Rightarrow I_{II} = 3A$$

$$U_C = E_4 - R_2 I_2 + R_5 I_5$$

$$U_C = 10 - 40 + 60 = 30V$$

$$Q_C = C U_C = 450 \mu C$$