Электротехника
РК №1

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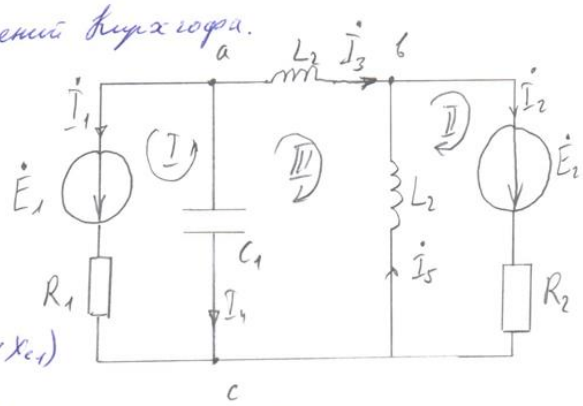
1) Рассчитать токи методом уравнений Кирхгофа.



$$\begin{cases} \text{узел } a: -\dot{I}_1 - \dot{I}_3 - \dot{I}_4 = 0 \\ \text{узел } b: \dot{I}_3 - \dot{I}_2 + \dot{I}_5 = 0 \\ \text{I контур}: \dot{E}_1 = \dot{I}_1 R_1 - \dot{I}_4 (-jX_{C1}) \\ \text{II контур}: \dot{E}_2 = \dot{I}_2 R_2 + \dot{I}_5 (jX_{L2}) \\ \text{III контур}: 0 = \dot{I}_3 jX_{L1} - \dot{I}_5 (jX_{L2}) - \dot{I}_4 (-jX_{C1}) \end{cases}$$

$$\left(\begin{array}{ccccc|c} -1 & 0 & -1 & -1 & 0 & 0 \\ 0 & -1 & 1 & 0 & 1 & 0 \\ 200 & 0 & 0 & j100 & 0 & 100+j100 \\ 0 & 200 & 0 & 0 & j100 & j100 \\ 0 & 0 & j100 & j100 & -j100 & 0 \end{array}\right)$$

По методу Крамера:

$\Delta = -4000000 - 5000000j$
$\Delta_1 = 2000000$
$\Delta_2 = 5000000 - 3000000j$
$\Delta_3 = 7000000 - 3000000j$
$\Delta_4 = -9000000 + 3000000j$
$\Delta_5 = -2000000$

$\dot{I}_1 = \frac{-8+10j}{41}$

$\dot{I}_2 = \frac{-5+37j}{41}$

$\dot{I}_3 = \frac{-13+43j}{41}$

$\dot{I}_4 = \frac{21-57j}{41}$

$\dot{I}_5 = \frac{8-10j}{41}$

$\dot{I}_{K1} = \frac{-8+j10}{41}$
$\dot{I}_{K2} = \frac{-5+j37}{41}$
$\dot{I}_{K3} = \frac{-13+j43}{41}$

Пункт 1 из ДЗ

$\dot{I}_1 = \dot{I}_{K1} = \frac{-8+j10}{41}$
$\dot{I}_2 = \dot{I}_{K2} = \frac{-5+j37}{41}$
$\dot{I}_3 = \dot{I}_{K3} = \frac{-13+j43}{41}$
$\dot{I}_4 = -\dot{I}_{K1} - \dot{I}_{K2} = \frac{21-j57}{41}$
$\dot{I}_5 = \dot{I}_{K2} - \dot{I}_{K3} = \frac{8-j10}{41}$

3) сопоставим результаты с 2):

Вывод: токи во всех 3х случаях одинаковы $\Rightarrow$ $\Rightarrow$ задача решена верно.

$\dot{I}_1 = (100+j100 - \frac{57}{41}\cdot 100 - j\frac{21}{41}100)\frac{1}{200} = \frac{10}{41} - \frac{8}{41} + j\frac{10}{41}$

$\dot{I}_2 = (j200 + \frac{-10}{41}\cdot 100 - j\frac{8}{41}\cdot 100)\cdot\frac{1}{200} = \frac{-5}{41} + j\frac{37}{41}$

$\dot{I}_3 = (\frac{-4200}{41} - j\frac{1300}{41})\cdot\frac{j}{100} = +j\frac{43}{41} - \frac{13}{41} = \frac{-13+j43}{41}$

$\dot{I}_4 = (\frac{-5200}{41} - j\frac{2100}{41})\cdot\frac{1}{100} = \frac{21-j57}{41}$

$\dot{I}_5 = (-\frac{-1000-j800}{41})(-j\frac{1}{100}) = \frac{8-j10}{41}$

Пункт 2 из ДЗ

№2 Расчитать энергетический баланс.

$$\sum P_{пр} = \sum P_{ист}$$

$$\sum P_{пр} = \sum I^2 R = 200\left(\sqrt{\left(\frac{8}{41}\right)^2+\left(\frac{10}{41}\right)^2}\right)^2 - j100\left(\sqrt{\left(\frac{21}{41}\right)^2+\left(\frac{54}{41}\right)^2}\right)^2 + j100\left(\sqrt{\left(\frac{13}{41}\right)^2+\left(\frac{42}{41}\right)^2}\right)^2 +$$

$$+ j100\left(\sqrt{\left(\frac{8}{41}\right)^2+\left(\frac{10}{41}\right)^2}\right)^2 + 200\left(\sqrt{\left(\frac{5}{41}\right)^2+\left(\frac{37}{41}\right)^2}\right)^2 =$$

$$= \frac{100}{41^2}\left(2\cdot 164 - j3690 + j2378 + j164 + 2\cdot 1394\right) =$$

$$= \frac{100}{41^2}\left(3116 - j1148\right) = \frac{7600 - j2800}{41}$$

$$\sum P_{ист} = \sum E\bar{I}^* = (100 + j100)\left(\frac{-8-10j}{41}\right) + j100\left(\frac{-5-37j}{41}\right) =$$

$$= \frac{100}{41}\left(-8+10+74 - j8 - j10 - j10\right) = \frac{7600 - j2800}{41}$$

$$\frac{7600 - j2800}{41} = \frac{7600 - j2800}{41}$$ - баланс сошёлся