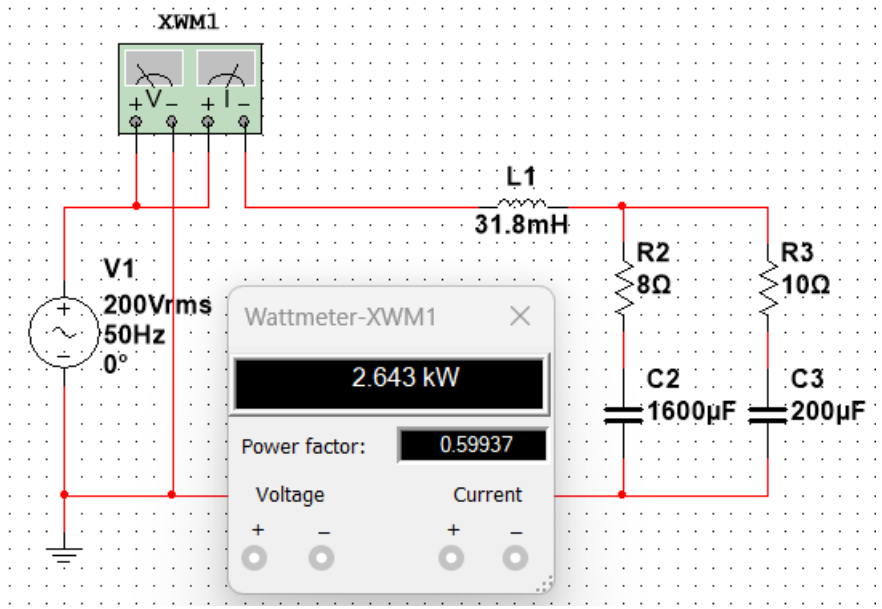
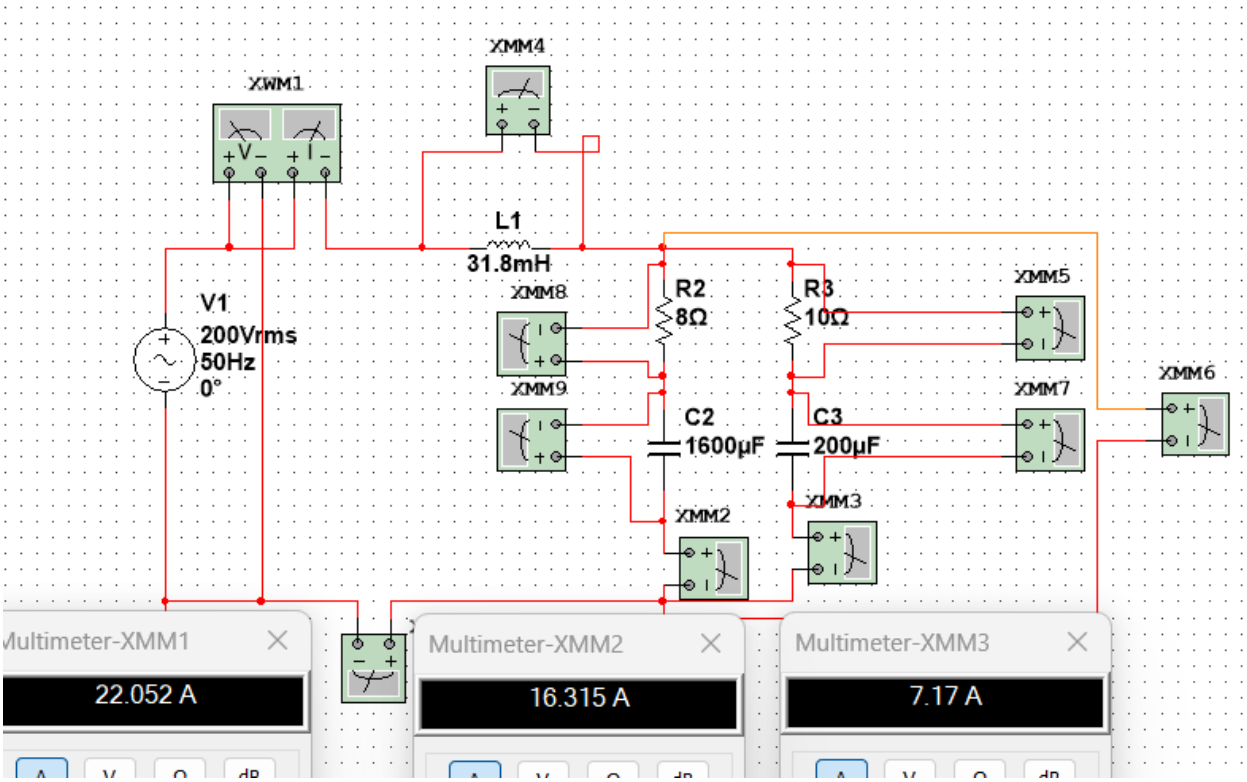
ЭЛЕКТРОТЕХНИКА БДЗ 2

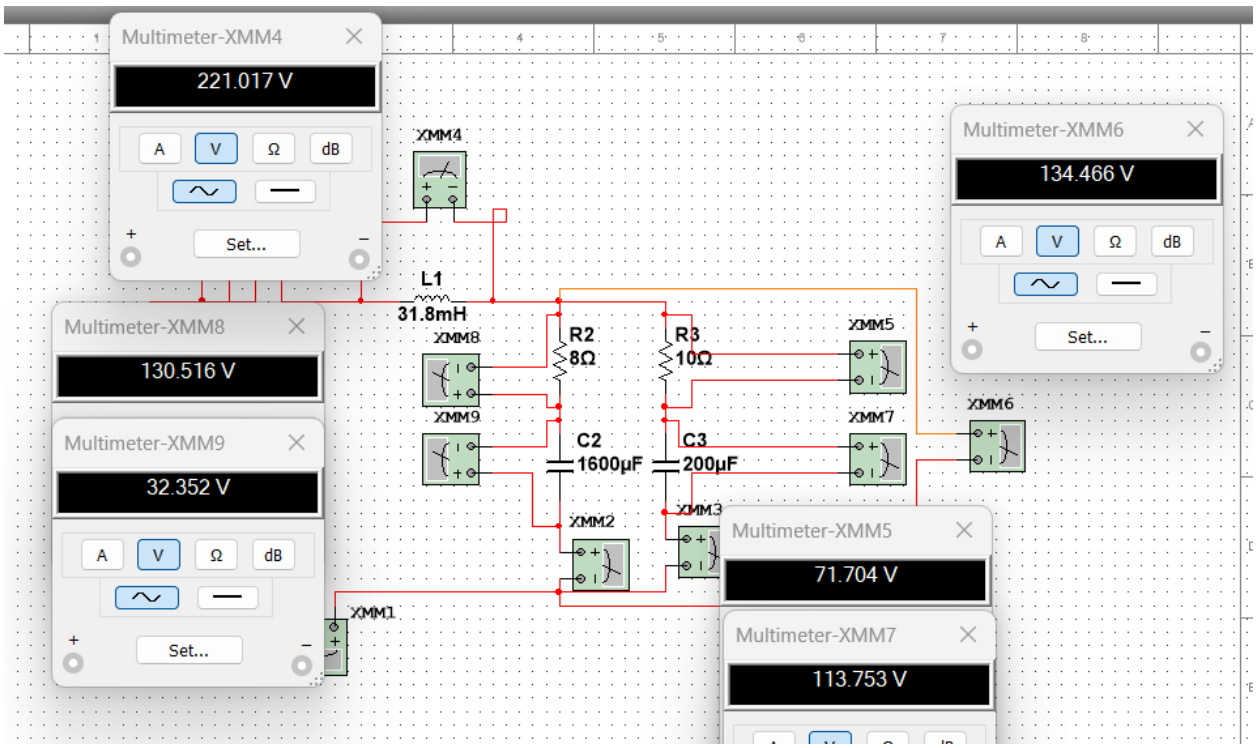
Моисеев Владислав ПИН-22



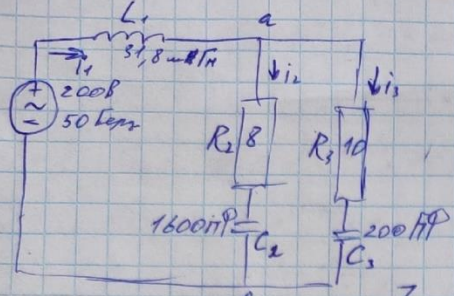
Силы токов на участках 1 2 3 соответственно



Напряжения на элементах


Multimeter-XMM4
221.017 V
A
V
Ω
dB
Set...
Multimeter-XMM8
130.516 V
Multimeter-XMM9
32.352 V
Multimeter-XMM6
134.466 V
Multimeter-XMM5
71.704 V
Multimeter-XMM7
113.753 V
XMM4
L1
31.8mH
XMM8
XMM9
R2
8Ω
R3
10Ω
C2
1600µF
C3
200µF
XMM5
XMM7
XMM6
XMM2
XMM3
XMM1

Моисеев ПИН-22 ДЗ-2



Найдем Сопротивления:

$Z_1 = j\omega L_1 = X_{L_1}$

$Z_2 = R_2 - j\frac{1}{\omega C_2} = X_{C_2}$

$Z_3 = R_3 - j\frac{1}{\omega C_3} = X_{C_3}$

$Z_1 = j \cdot 2\cdot\pi\cdot 50 \cdot 31{,}8\cdot 10^{-3} = j9{,}99 = 9{,}99\, e^{i(90^\circ)}$

$Z_2 = 8 - j\frac{1}{2\cdot\pi\cdot 100\cdot 1600\cdot 10^{-6}} = 8 - j1{,}99 \approx 8{,}24\cdot e^{j(-0{,}24)}$ или $8{,}24\cdot e^{i(-14^\circ)}$

$Z_3 = 10 - j\frac{1}{2\pi\cdot 50\cdot 200\cdot 10^{-6}} = 10 - j15{,}92 \approx 18{,}8\cdot e^{i}$ или $18{,}8\cdot e^{i(-57{,}9^\circ)}$

Токи и напряжение

$\dot{U} = E = 200$ В

$\dot{I}_1 = \frac{\dot{U}}{Z_1} \ominus \left[Z = Z_1 + Z_{23} = Z_{L_1} + \left[Z_{23} = \frac{Z_2 Z_3}{Z_2 + Z_3} = \frac{(8 - j1{,}99)(10 - j15{,}92)}{18 - j(1{,}99 + 15{,}92)} = \right.\right.$

$= \frac{11{,}64 - j147{,}26}{18 - j17{,}91} = \frac{215{,}52\cdot e^{i(-56{,}28^\circ)}}{25{,}39\cdot e^{i(-44{,}86^\circ)}} \approx 8{,}49\cdot e^{j(-11{,}42^\circ)} = Z_{23} \left.\right]$

$Z = 9{,}99 e^{j(90)} + 8{,}49 e^{j(-11{,}42)} = 9{,}99j + 3{,}49 - 7{,}74j = 5{,}49 + 2{,}25j = 4{,}15 e^{i(32{,}8^\circ)} \left.\right]$

$\ominus \frac{200}{4{,}15 e^{i(32{,}8^\circ)}} = 48{,}19\cdot e^{i(-32{,}8^\circ)}$

$= \frac{48{,}32 - 147{,}26j}{18 - 17{,}91j} = \frac{154{,}98 e^{i(-71{,}83^\circ)}}{25{,}39 e^{i(-44{,}86^\circ)}} = 6{,}1 e^{i(-26{,}97^\circ)} \approx 5{,}44 - 2{,}77j = Z_{23} \left.\right]$

$Z = 9{,}99j + 5{,}44 - 2{,}77j = 5{,}44 + 7{,}22j = 9{,}04\cdot e^{i(53^\circ)} \left.\right]$

$\ominus \frac{200}{9{,}04\cdot e^{i(53^\circ)}} = 22{,}12\cdot e^{i(-53^\circ)}$ A $= \dot{I}_1$

$\dot{U}_2 = \dot{U}_3 = \dot{U}_{23} = \dot{I}_1 \cdot Z_{23} = 22{,}12 e^{i(-53)} \cdot 6{,}1 e^{i(-26{,}97^\circ)} = 134{,}93\cdot e^{i(80^\circ)}$

$\dot{I}_2 = \frac{\dot{U}_{23}}{Z_2} = \frac{134{,}93\cdot e^{i(80^\circ)}}{8{,}24 e^{i(-14)}} = 16{,}38\cdot e^{i(66^\circ)}$ A

$\dot{I}_3 = \frac{\dot{U}_{23}}{Z_3} = \frac{134{,}93 e^{i(80^\circ)}}{18{,}8\cdot e^{i(-57{,}9^\circ)}} \approx 7{,}18\cdot e^{i(122{,}1^\circ)}$ A

Напряжения:

$\dot{U}_{L_1} = \dot{I}_1 \cdot jX_L = 22,12 \cdot e^{j(-53°)} \cdot 9,99 \cdot e^{j(90°)} = 221 \cdot e^{j(37°)}$ (В)

$\dot{U}_{C_2} = \dot{I}_2 \cdot (-jX_{C_2}) = \dot{I}_2 \cdot \frac{1}{\omega \cdot C_2} = 16,38 \cdot e^{j(66°)} \cdot 1,99 = 32,60 \cdot e^{j(66°)}$ (В)

$\dot{U}_{C_3} = \dot{I}_3 \cdot X_{C_3} = 7,18 \cdot e^{j(22,1°)} \cdot 15,92 = 114,3 e^{j(22°)}$ (В)

$\dot{U}_{R_2} = \dot{I}_2 \cdot R_2 = 16,38 \cdot e^{j(66)} \cdot 8 = 131,04 e^{j(66°)}$ (В)

$\dot{U}_{R_3} = \dot{I}_3 R_3 = 7,18 e^{j(22,1°)} \cdot 10 = 71,8 e^{j(22,1°)}$ В

Мощность сис агрегата:

$\dot{S} = U \cdot \dot{I}_1 = 200 \cdot 22,12 \cdot e^{j(-53°)} = 4424 e^{j(-53°)} = 2662,43 - j3533,16$ ВА

активная $P = 2662,43$ ВА, реактивная $Q = 3533$ ВА

$P' = \dot{I}_2^2 R_2 + \dot{I}_3^2 R_3 = 16,38^2 \cdot 8 + 7,18^2 \cdot 10 = 2661,96$ (ВА.)

$Q' = \dot{I}_1^2 X_{L_1} + \dot{I}_2^2 X_{C_2} + \dot{I}_3^2 X_{C_3} = 22,12^2 (0,6 - j0,8)^2 \cdot 9,99 + 16,38^2 (0,41 + j0,91)^2 \cdot 1,99 + 7,18^2 (0,93 + j0,38)^2 \approx -3653$

$Q' = I_1^2 X_L + I_2^2 X_{C_2} + I_3^2 X_{C_3} = 22,12^2 \cdot 9,99 - 16,38^2 \cdot 1,99 - 7,18^2 \cdot 15,92 = 3533$ (ВА)

$|P| \approx |P'|$, $|Q| \approx |Q'|$

$\dot{I}_1 = 13,71 - 18,03j$

$\dot{I}_2 = 6,35 - 15,57j$

$\dot{I}_3 = 7,38 - 2,46j$

$\dot{U}_{L_1} = 137,19 - 180,18j$

$\dot{U}_{C_2} = 12,64 - 30,98j$

$\dot{U}_{C_3} = 117,484 - 39,22j$

$\dot{U}_{R_2} = 50,81 - 124,56j$

$\dot{U}_{R_3} = 73,82 - 24,64j$

$\dot{U}_{23} = 19,84 - 137,19j$

Диаграмма токов

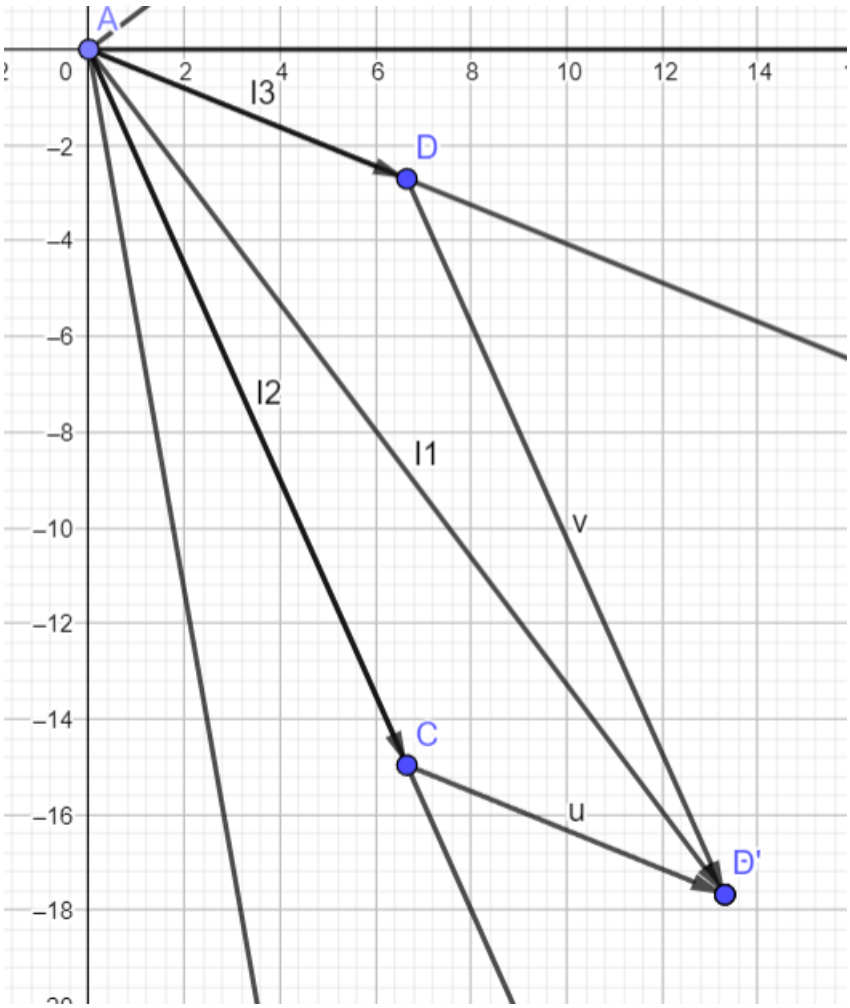
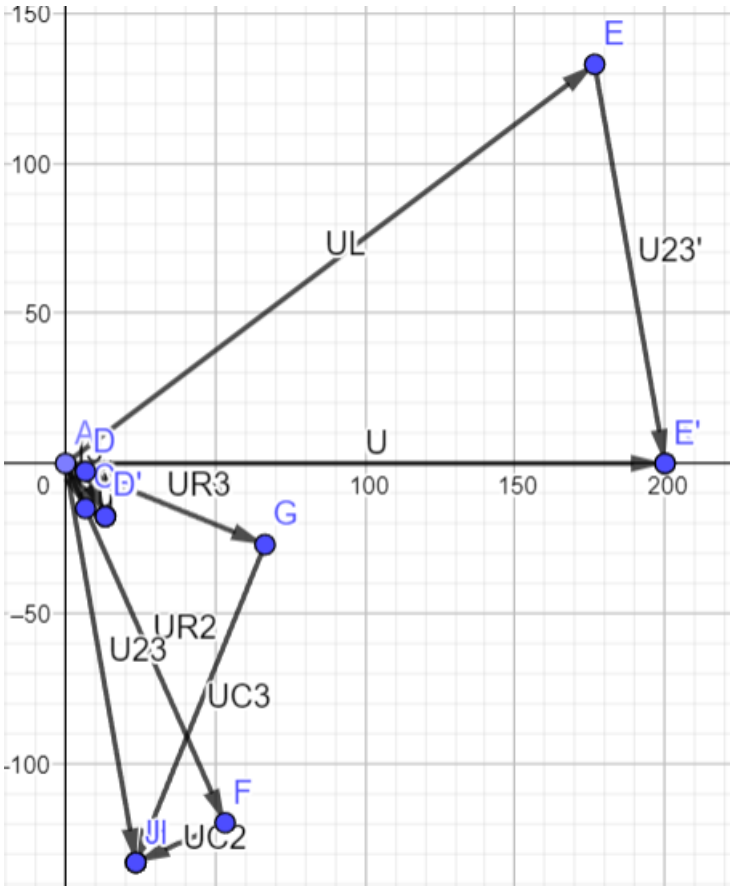


Диаграмма напряжений


150
100
50
0
-50
-100
100
150
200
E
UL
U23'
A
D
C
D'
UR3
U
E'
G
UR2
U23
UC3
F
UI
UC2