Лабораторная работа №2

Исследование цепей однофазного синусоидального тока

Цель работы:

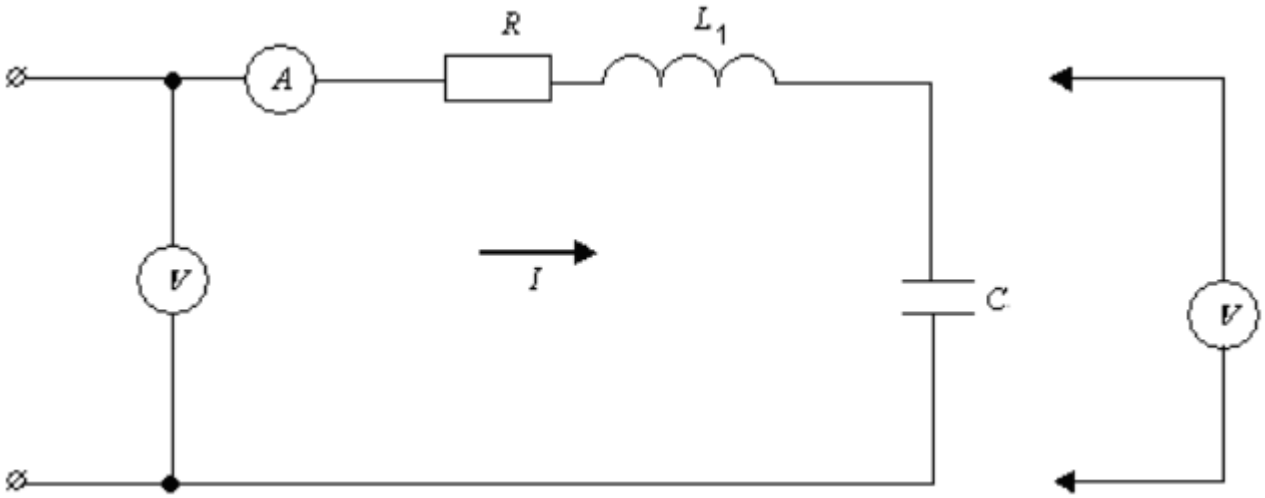
Получение навыков эксперементального исследования цепей однофазного синусоидального тока.

Ответы на вопросы подготовки:

1)

$$I = \frac{U}{Z};\quad U_R = R * I_R;\quad U_L = i\omega \mathrm{L} I_L;\quad U_C = \frac{1}{i\omega C} I_C$$

1)




```
label = {'В';'Гц';'Ом';'Гн';'Ф';'А';'В';'В';'В';'Ом'};
val = [4;1000;51;30e-3;1.2e-6;35.4e-3;1.85;7.96;5.2;1.9];
T = table(label,val,...
    'VariableNames',{'unit','value'},...
    'RowNames',{'U','fi','R','L','C','I','U_r','U_l','U_c','R_l'}...
)
```

T = 10×2 table

	unit	value
1 U	'В'	4
2 fi	'Гц'	1000
3 R	'Ом'	51
4 L	'Гн'	0.0300

	unit	value
5 C	'Ф'	1.2000e-06
6 I	'A'	0.0354
7 U_r	'B'	1.8500
8 U_l	'B'	7.9600
9 U_c	'B'	5.2000
10 R_l	'Ом'	1.9000

```
omeg = T{'fi','value'}*2*pi;
X_C = 1/(omeg*T{'C','value'}*i);
X_L = omeg*T{'L','value'}*i + T{'R_l', 'value'};
X_R = T{'R','value'};
Z = X_C+X_L+X_R
```

```
Z = 52.9000 + 55.8664i
```

```
I = T{'U','value'}/Z
```

```
I = 0.0357 - 0.0378i
```

```
U_R = I*X_R;
U_C = I*X_C;
U_L = I*X_L;
```

Мощности:

```
S_ist = round(I*T{'U','value'},5)
```

```
S_ist = 0.1430 - 0.1510i
```

```
S_nagr = round(I*(U_R+U_L+U_C),5)
```

```
S_nagr = 0.1430 - 0.1510i
```

Погрешности:

```
d_P = (real(S_ist) - real(S_nagr))/real(S_ist)
```

```
d_P = 0
```

```
d_Q = (imag(S_ist) - imag(S_nagr))/imag(S_ist)
```

```
d_Q = 0
```

Проверка 2 закона Киргофа:

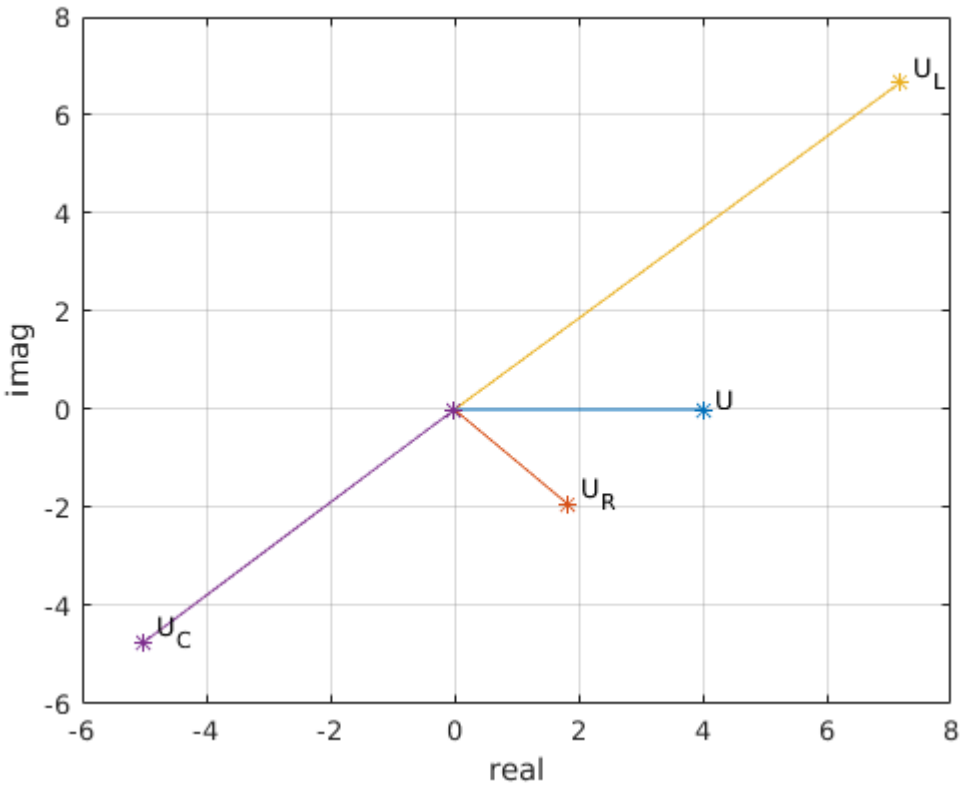
```
round(U_R+U_C+U_L , 5) == T{'U','value'}
```

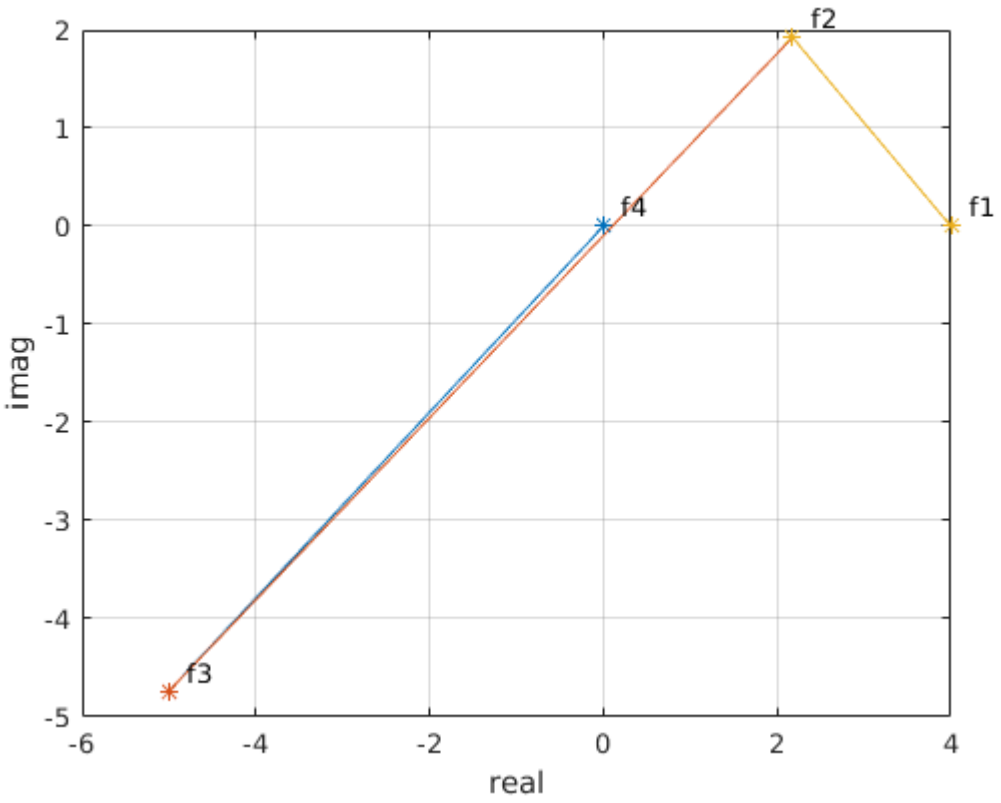
```
ans = logical
```

```
1
```

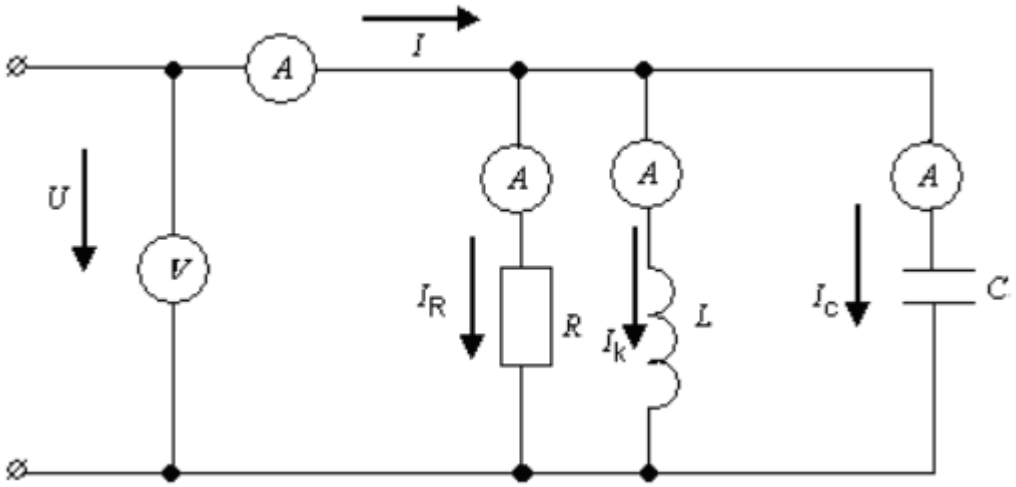
Графики:

```
imag2plot({T{'U', 'value'} U_R U_L U_C}, {'U' 'U_R' 'U_L' 'U_C'});

f4 = 0;
f3 = f4 + U_C;
f2 = f3 + U_L;
f1 = f2 + U_R;
f4 = f1 - T{'U','value'};

imag2plot_2({{f4 f3 f2 f1 }}, {{'f4' 'f3' 'f2' 'f1'}});
```





2)




```
label = {'В';'Гц';'Ом';'Гн';'Ф';'А';'А';'А';'А';'Ом'};
val = [4;1000;51;30e-3;1.2e-6;52.6e-3;52.4e-3;14.5e-3;19.8e-3;1.9];
T = table(label,val,...
    'VariableNames',{'unit','value'},...
    'RowNames',{'U','fi','R','L','C','I','I_r','I_l','I_c','R_l'}...
    )
```

```
T = 10×2 table
```

	unit	value
1 U	'В'	4
2 fi	'Гц'	1000
3 R	'Ом'	51
4 L	'Гн'	0.0300
5 C	'Ф'	1.2000e-06
6 I	'А'	0.0526
7 I_r	'А'	0.0524
8 I_l	'А'	0.0145
9 I_c	'А'	0.0198
10 R_l	'Ом'	1.9000

```
omeg = T{'fi','value'}*2*pi;
X_C = 1/(omeg*T{'C','value'}*i);
X_L = omeg*T{'L','value'}*i + T{'R_l','value'};
X_R = T{'R','value'};
Z = (1/X_R + 1/X_L + 1/X_C)^-1
```

```
Z = 50.2123 - 5.7084i
```

```
Z_12 = (1/X_R + 1/X_L)^-1;
Z_23 = (1/X_L + 1/X_C)^-1;
Z_13 = (1/X_R + 1/X_C)^-1;

I = T{'U','value'}/Z
```

```
I = 0.0786 + 0.0089i
```

```
I_R = I* Z_23/(Z_23 + X_R);
I_L = I* Z_13/(Z_13 + X_L);
I_C = I* Z_12/(Z_12 + X_C);
```

Мощности:

```
S_ist = round(I*T{'U','value'},5)
```

```
S_ist = 0.3146 + 0.0358i
```

```
S_nagr = round(I_R^2*X_R+I_L^2*X_L+I_C^2*X_C,5)
```

```
S_nagr = 0.3146 + 0.0358i
```

Погрешности:

```
d_P = abs((real(S_ist) - real(S_nagr)))/real(S_ist)
```

```
d_P = 0
```

```
d_Q = abs((imag(S_ist) - imag(S_nagr)))/imag(S_ist)
```

```
d_Q = 0
```

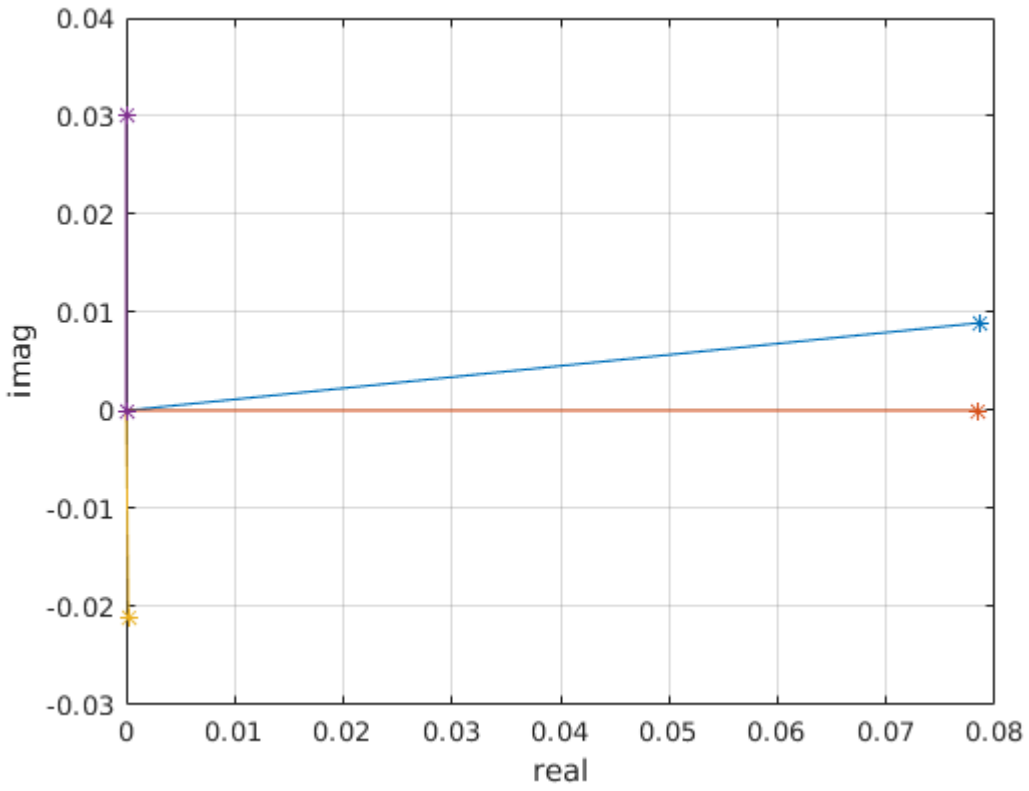
Проверка 1 закона Кригофа:

```
round(I_R+I_L+I_C,5) == round(I,5)
```

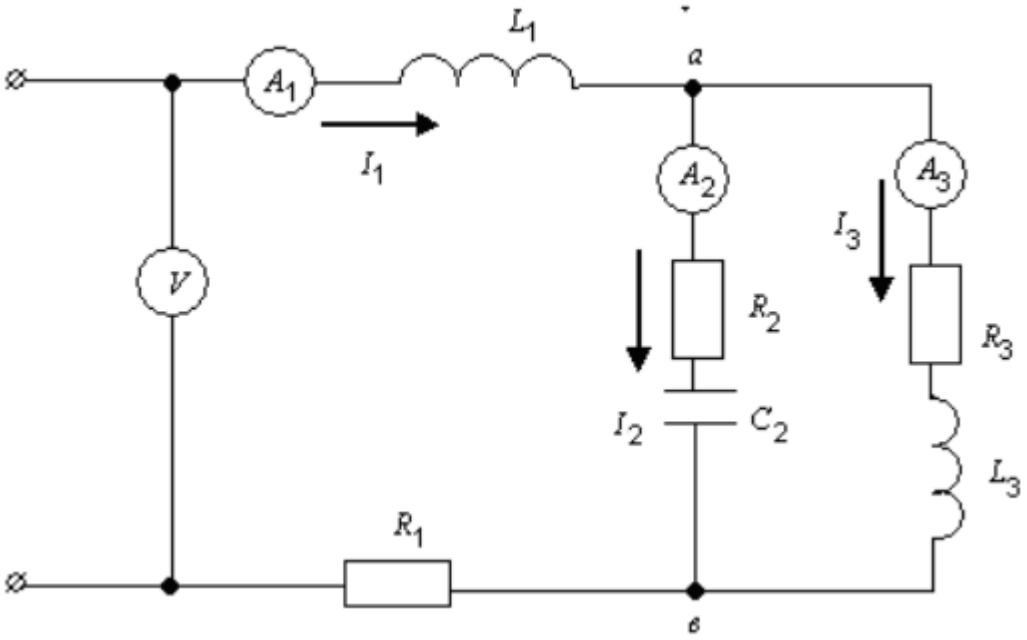
```
ans = logical
   1
```

Графики:

```
imag2plot({I I_R I_L I_C},{'I' 'I_R' 'I_L' 'I_C'})
```



3)




```
label = {'В';'Гц';'Ом';'Ом';'Ом';'Гн';'Гн';'Ф';'Ом';'Ом';'А';'А';'А';'В';'В';'В';'В';'
val = [4;1000;132.1;51;99.1;10e-3;30e-3;1.2e-6;1.1;1.8;15.5e-3;19.7e-3;13.6e-3;2;1;1.4,
T = table(label,val,...
    'VariableNames',{'unit','value'},...
    'RowNames',{'U','fi','R_1','R_2','R_3','L_1','L_3','C_2','R_L_1','R_L_3','I_1','I_2
    )
```

T = 19×2 table

	unit	value
1 U	'В'	4
2 fi	'Гц'	1000
3 R_1	'Ом'	132.1000
4 R_2	'Ом'	51
5 R_3	'Ом'	99.1000
6 L_1	'Гн'	0.0100
7 L_3	'Гн'	0.0300
8 C_2	'Ф'	1.2000e-06
9 R_L_1	'Ом'	1.1000
10 R_L_3	'Ом'	1.8000
11 I_1	'А'	0.0155
12 I_2	'А'	0.0197
13 I_3	'А'	0.0136
14 U_R_1	'В'	2
15 U_R_2	'В'	1

	unit	value
16 U_R_3	'B'	1.4000
17 U_L_1	'B'	1.1000
18 U_L_3	'B'	2.7000
19 U_C_2	'B'	2.9000

```
omeg = T{'fi','value'}*2*pi;
X_R_1 = T{'R_1','value'};
X_R_2 = T{'R_2','value'};
X_R_3 = T{'R_3','value'};
X_L_1 = omeg*T{'L_1','value'}*i + T{'R_L_1', 'value'};
X_L_3 = omeg*T{'L_3','value'}*i + T{'R_L_3', 'value'};
X_C_2 = 1/(omeg*T{'C_2','value'}*i);
Z_2 = X_R_2 + X_C_2;
Z_3 = X_R_3 + X_L_3;
Z_23 = (1/Z_2 + 1/Z_3)^-1;
Z = X_R_1 + Z_23 + X_L_1
```

```
Z = 2.9997e+02 - 2.3318e+01i
```

```
I = T{'U','value'}/Z
```

```
I = 0.0133 + 0.0010i
```

```
I_2 = I*Z_3/(Z_3+Z_2)
```

```
I_2 = 0.0122 + 0.0127i
```

```
I_3 = I*Z_2/(Z_2+Z_3)
```

```
I_3 = 0.0011 - 0.0116i
```

```
U_R_1 = I*X_R_1;
U_R_2 = I_2*X_R_2;
U_R_3 = I_3*X_R_3;
U_L_1 = I*X_L_1;
U_L_3 = I_3*X_L_3;
U_C_2 = I_2*X_C_2;
```

Мощности:

```
S_ist = round(I*T{'U','value'},5)
```

```
S_ist = 0.0530 + 0.0041i
```

```
S_nagr = round(I^2*(X_R_1+X_L_1)+I_2^2*(X_R_2+X_C_2)+I_3^2*(X_R_3+X_L_3),5)
```

```
S_nagr = 0.0530 + 0.0041i
```

Погрешности:

```
d_P = abs((real(S_ist) - real(S_nagr)))/real(S_ist)
```

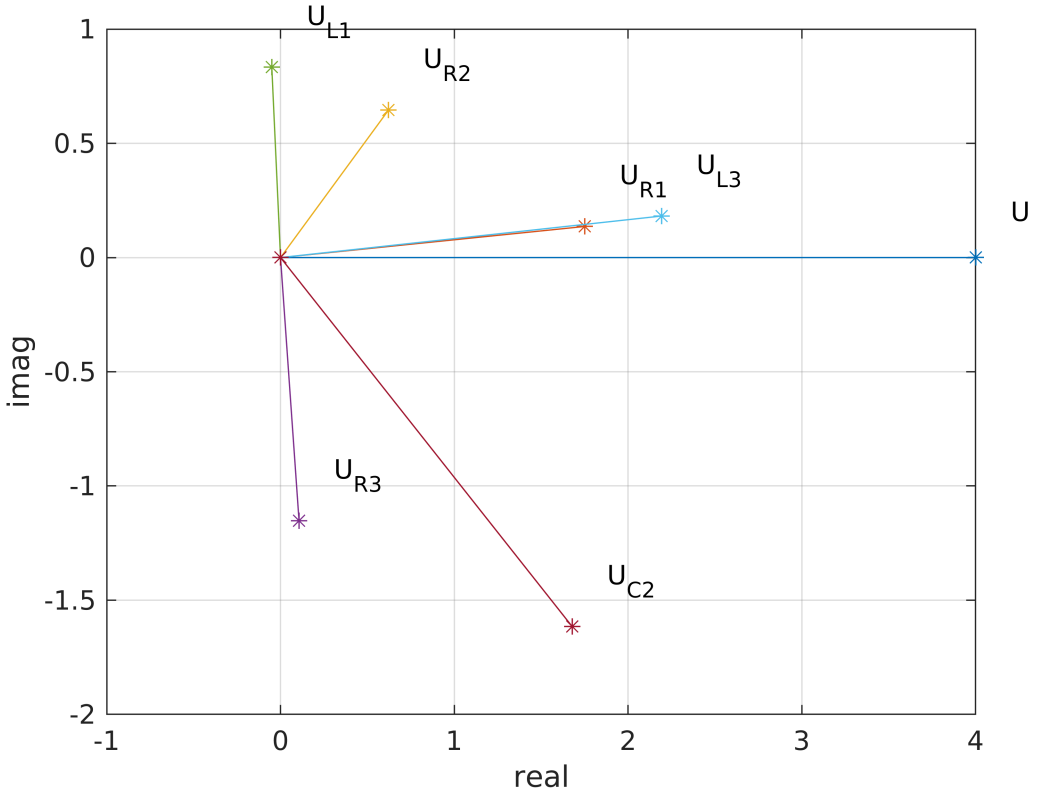
```
d_P = 0
```

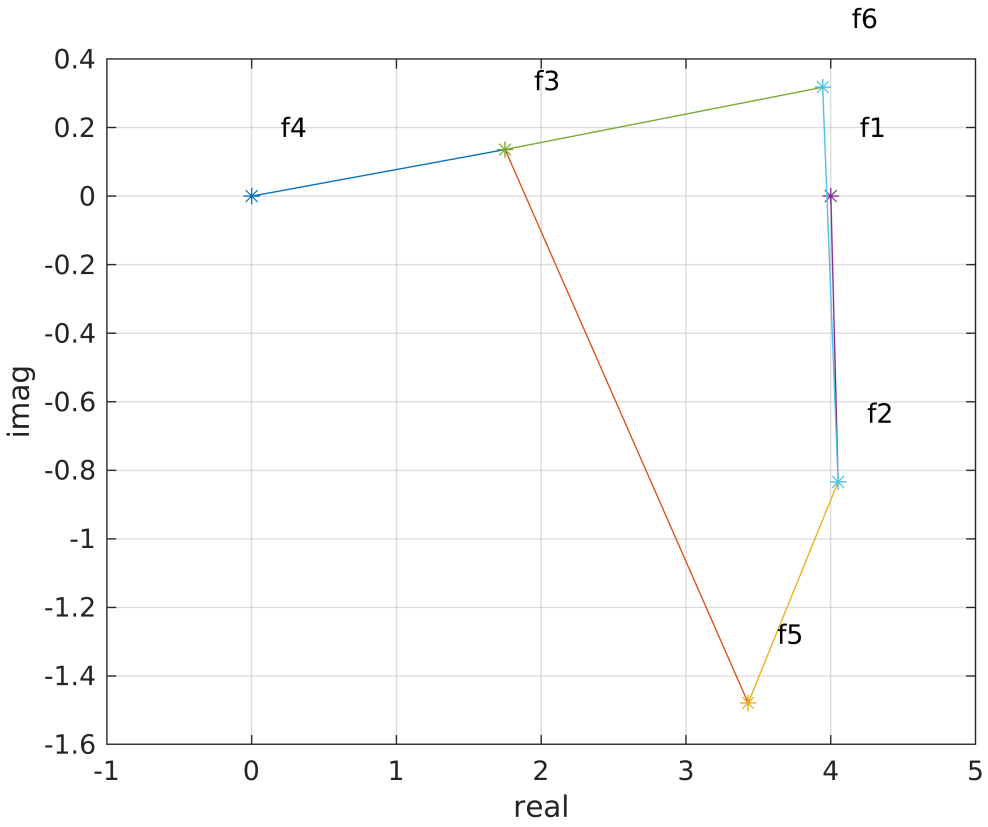
```
d_Q = abs((imag(S_ist) - imag(S_nagr)))/imag(S_ist)
```

```
d_Q = 0
```

Графики:

```
imag2plot({T{'U','value'} U_R_1 U_R_2 U_R_3 U_L_1 U_L_3 U_C_2},{'U' 'U_R_1' 'U_R_2' 'U_
f4 = 0;
f3 = f4 + U_R_1;

f5 = f3 + U_C_2;
f2 = f5 + U_R_2;

f6 = f3 + U_L_3;
f2 = f6 + U_R_3;

f1 = f2 + U_L_1;
f4 = f1 - T{'U','value'};

imag2plot_2({{f4 f3 f5 f2 f1} {f3 f6 f2}},{{'f4' 'f3' 'f5' 'f2' 'f1'} {'f3' 'f6' 'f2'}
```





Вывод:

Я получил навыки эксперементального исследования цепей однофазного синусоидального тока.