

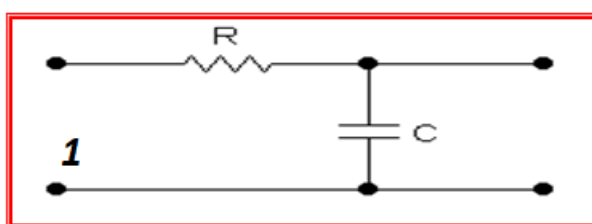
2 - LABORATORIYA ISHI

ELECTRONICS WORKBENCH va MULTISIM kompyuter dasturlari yordamida sxemalar yig'ishni o'rganish

Ishning maqsadi :Elektronika va mikroprofessorli texnika fanini o'qitishda ElectronicsWorkbench (Multisim) dasturidan foydalanish ko'nikmalarini shakllantirish.

RC-zanjir chastota xarakteristikalarini o'rganish

Eng soda RC-zanjir 1- rasmdakeltirilgan.



1-rasm. RC-zanjir sxemasi

RC-zanjir kompleks kirish qarshiligi quyidagi ifodaga teng:

$$Z_{vx} = R_{vx} + jX_{vx} = R + 1/(j\omega C) = R[1 - j/(\omega CR)]. \quad (1)$$

Kirish qarshiligining aktiv qismi $R_{kir}=R$ chastotaga bog'liqemas, reaktiv qismi esa $X_{kir} = -1/(\omega S)$ – bog'liq bo'ladi.

$\tau =RC$ vaqt o'lchami bilan o'lchanadi va RC -zanjir vaqt doimiysi deyiladi.

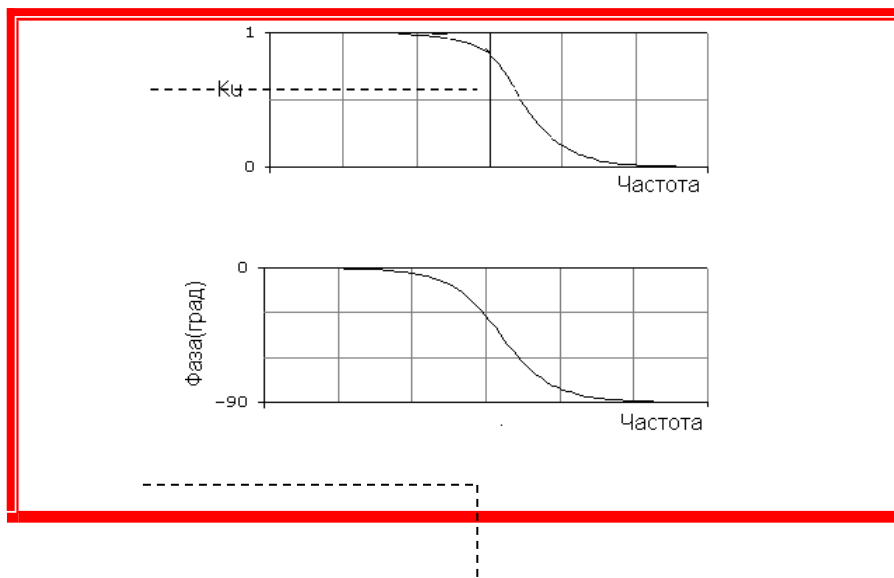
Zanjirning kompleks uzatish koeffitsienti quyidagi ifodaga teng:

$$K_u(j\omega) = \dot{U}_2/\dot{U}_1 = [1/(j\omega C)]/Z_{vx} = 1/(1+j\omega C). \quad (2)$$

Amplituda-chastota va faza-chastota xarakteristikalari quyidagi ko'rinishga ega bo'ladi:

$$K_u(\omega) = 1/\sqrt{1+\omega^2\tau^2} ;$$
$$\varphi(\omega) = \arctg (ImK(j\omega)/ReK(j\omega)) = - \arctg\omega\tau . \quad (3)$$

Amplituda-chastota va faza-chastota xarakteristikalari 2-rasmda keltirilgan.



2- rasm. Amplituda-chastota va faza-chastota xarakteristikalari

2-rasmdagi grafiklardan ko‘rinib turibdiki, RC-zanjir faqat past chastotalarni o‘tkazadi va yuqorichastotalarni esa o‘tkazmaydi. Chastota oshib borishi bilan kirish va chiqish signallari o‘rtasidagi faza siljishi 90^0 ni tashkil etadi.

O‘tkazish polosasi quyidagi shart bajarilgandagi chastota

$$K_u(\omega) \geq 1/\sqrt{2} \quad (4)$$

shart boshlanadigan chastotaga kesilish chastotasi ω_{sr} deyiladi. Kesilish chastotasida (2- rasmda punktir chiziq):

$$K_u(\omega_{sr}) = 1/\sqrt{1+(\omega_{sr})^2\tau^2} = 1/\sqrt{2}. \quad (5)$$

Bu yerdan $\omega_{sr} = 1/\tau$ kelib chiqadi.

Topshiriq

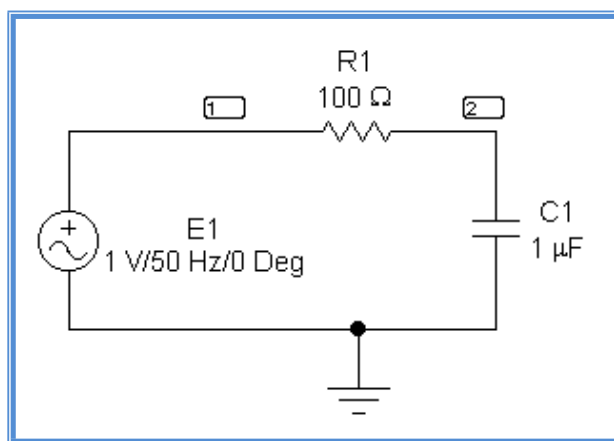
3-rasmda keltirilgan sxemani yig‘ing. R va Cning qiymatlarini o‘zgartira borib, zanjirning amplituda-chastota va faza-chastota xarakteristikalarini chizing. O‘lchash natijalarini jadvalga kirgizing.

Bajarish tartibi (1- usul)

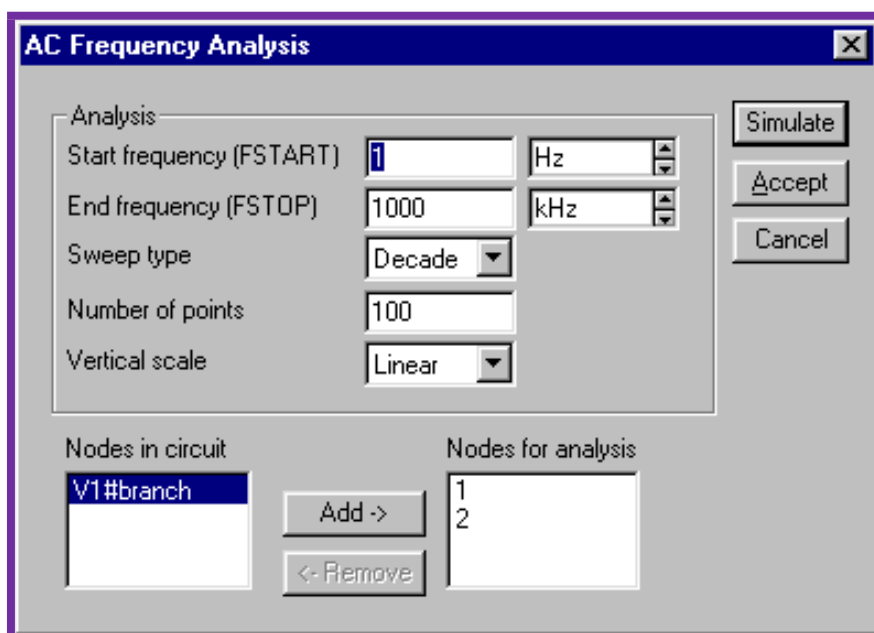
1) **O‘lchash sxemasini tayyorlash.** 3-rasmda keltirilgan sxema bo‘yicha qarshilik va sig‘im qiymatlarini o‘rnatish. *Analysis* menyusida *ACFrequency* rejimini tanlang, bu amplituda-chastota va faza-chastota xarakteristikalarini tahlil qilish rejimidir. Paydo bo‘lgan oynada modellashtirish parametrlarini o‘rnatish (4- rasm). Bizning misolimizda kirish signali chastotasi 1 Gs dan 1000 gS gacha o‘zgaradi. Sxemaning 1 va 2 nuqtalari (*Nodes for analysis*) signallari amplitudalari 0V – 1V oralig‘ida,

signallar fazalari $0^{\circ} - 90^{\circ}$ oralig'ida vertikal o'qda chiziqli masshtabda (*Linear*), chastota esa gorizontal o'q bo'yicha dekadalarda (10Gs, 100Gs, 1kGs va h.k.) o'rnatiladi.

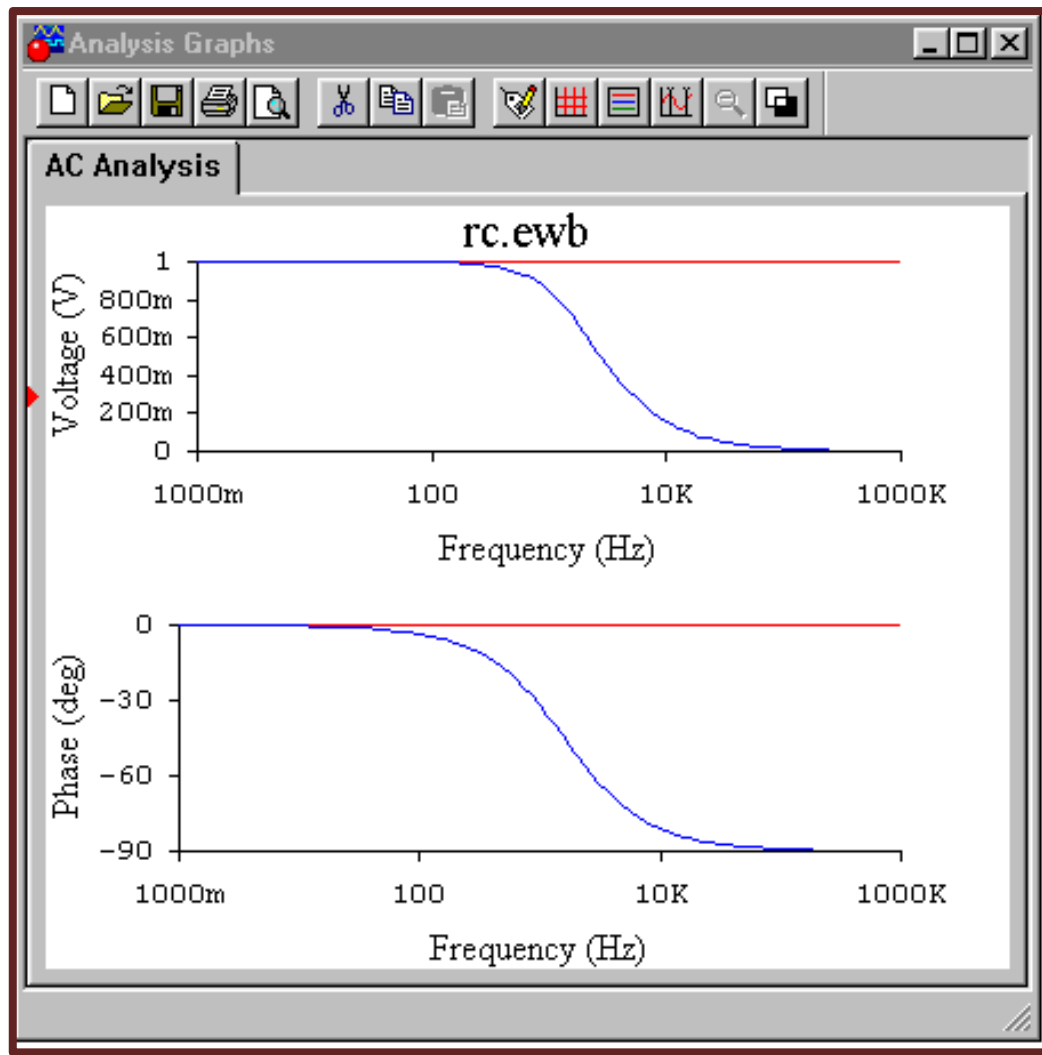
2) **O'lchashlar.** *Simulate* tugmasini bosing (4- rasm). Ekranda RC-zanjir berilgan parametrlariga mos amplituda-chastota (yuqoridagi) va faza- chastota (quyidagi) xarakteristikalarini ko'rsatuvchi diagrammalar paydo bo'ladi (5- rasm).



3- rasm. RC – zanjirni o'rganish sxemasi



4- rasm. O'lchash parametrlarini o'rnatish

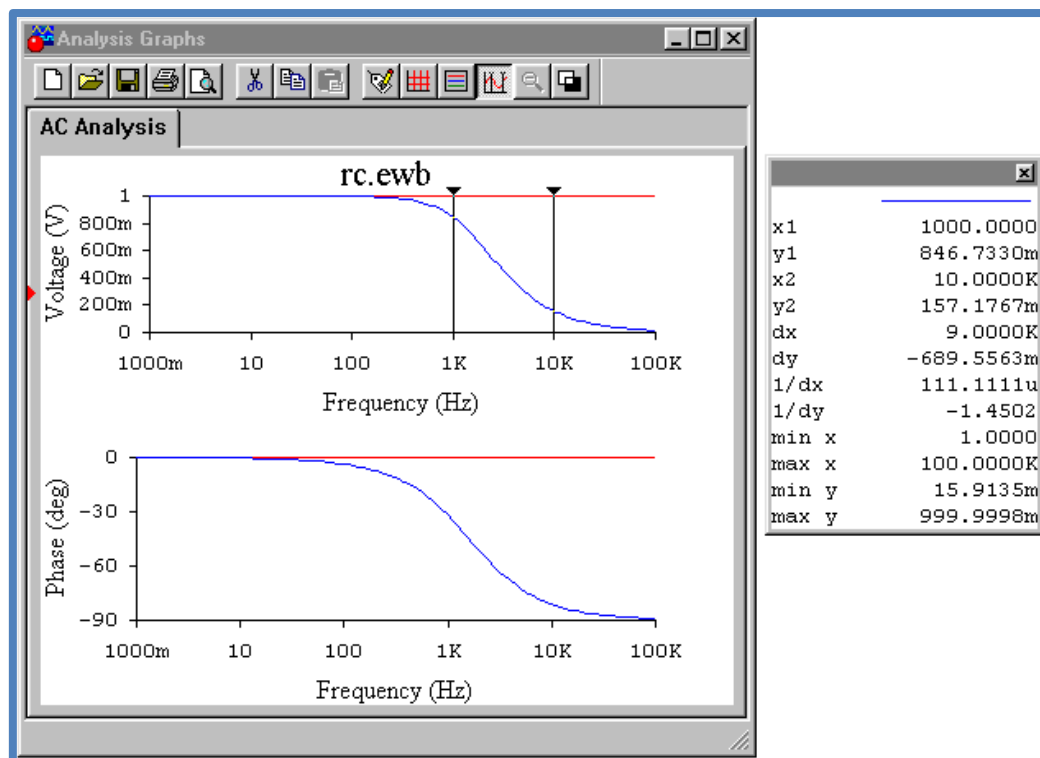


5- rasm. O‘lchov natijalari

Kerakli egri chiziqda kattaliklarning miqdorlarini ko‘rish uchun kursorni shu chiziq ustiga olib borib, sichqonchani chap tugmasini va quyidagi tugmani bosish kerak:



Grafiklarda vizir chiziqlari va sonli qiymatlarni ko‘rsatuvchi oyna paydo bo‘ladi (6-rasm). Vizir chizig‘ining ustiga kursorni olib borib, sichqonchani chap tugmasini bosib, uni qo‘yib yubormasdan, vizir chizig‘ini grafikning istalgan joyiga olib borish mumkin. Bu vaqtda qo‘shni oynada kattaliklarning sonli miqdorlari aks etib turiladi, xususan X1, Y1lar – birinchi vizir chizig‘i va xarakteristkaning kesishish nuqtalari chastota va amplitudasi (1000 Gs i 846,733 mV), X2, Y2 lar – ikkinchi vizir chizig‘i va xarakteristkaning kesishish nuqtalari chastota va amplitudasi (10 kGs i 157,1767 mV) ni ko‘rsatadi.



6- rasm. O'lchashlarning sonli natijalari

Vizir chiziqlaridan foydalanib, amplituda-chastotava faza-chastota xarakteristikalarini oling, natijalarni 3-va 4- jadvallarga kirgizing.

Zanjir parametrlarini o'zgartiring va yuqorida keltirilgan usullar bilan xarakteristikalarini RvaC ning turli qiymatlarida oling. Natijalarni 3- va 4- jadvallarga kirgizing.

Natijalar tahlili

O'lchov natijalari asosida amplituda-chastotava faza-chastota xarakteristikalarini chizing.

Bajarish tartibi (2 - usul).

3- rasmda keltirilgan sxema bo'yicha qarshilik va sig'im qiymatlarini o'rnatish

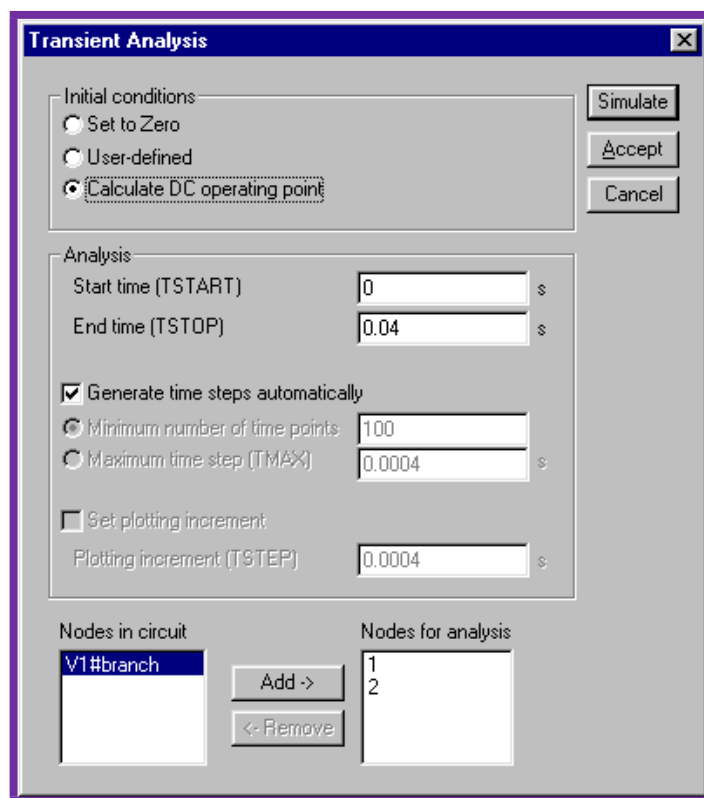
3- jadval

R(Ohm)	C(mKf)	K1	f1 (Gs)	Kn	fn (Gs)
1	1						
	10						
	100						
10	1						
	10						
	100						
100	1						
	10						
	100						

R(Ωm)	C(mKf)	K1	f1 (Gs)	Kn	fn (Gs)
1	1						
	10						
	100						
10	1						
	10						
	100						
100	1						
	10						
	100						

1) **O'lchov sxemasini tayyorlash.** *Analysis* menyusida *Transient* rejimini tanlang, bu rejim o'tish xarakteristikalarini o'rganadi. Paydo bo'lgan oynada (7-rasm) modellashtirishning keltirilgan parametrlarini o'rnatish. Keltirilgan misolda kirish signali chastotasi 50 Gs, amplitudasi 1 V ni tashkil etadi. Tahlil vaqtining davomliligi *End time (TSTOP)* = 0,04 s (bu interval davomliligi shunday tanlanishi kerakki, ossillogrammada tekshirilayotgan tebranishlarning 2-5ta davri o'z aksini topsin).

2) **O'lchashlar.** *Simulate* tugmasini bosing (7-rasm). Ekranda kirish va chiqish signallarini aks ettiruvchi oyna paydo bo'ladi (50 Gs chastota uchun 8-rasm). Rasmdan ko'rinib turibdiki, RC – zanjirning berilgan parametrlari bo'yicha kirish va chiqish signallari orasidagi fazalar farqi 0 ga teng, amplitudalar deyarli bir- biriga teng. Generator chastotasini o'zgartira borib, amplituda-chastotava faza-chastota xarakteristikalarini oling. Generator chastotasini o'zgartirish uchun kursorni generator ustiga olib borib, sichqonchaning o'ng tugmasini bosing. Generator tasviri qizil tusga kiradi va ekranda menyu RC paydo bo'ladi. Menyuda *Component Properties* opsiyasini tanlang, *Component Properties* paydo bo'lgan zakladkada (*Value* zakladkasida) chastotaning yangi qiymatini o'rnatish. 9-rasmda 10 kGs chastota uchun tahlil natijalari keltirilgan (TSTOP=0,0002).



7- rasm. *Transient* rejimi parametrlarini sozlash

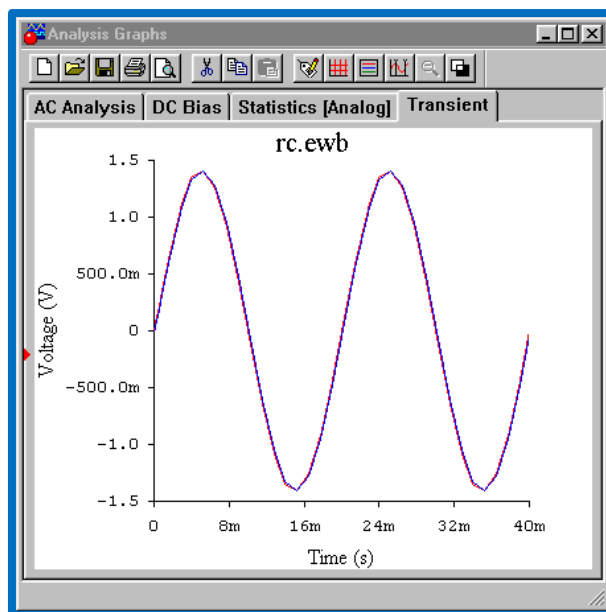
Kattaliklarning miqdorlarini o‘lchash uchun bizni qiziqtirayotgan egri chiziqqa kursorni iolib borib, sichonchanning chaptugmasinibosib turib, quyidagi tugmani:



Bosish kerak. Grafiklarda vizir chiziqlari va kattaliklarning miqdorlari aks ettirilgan oynachalar paydo bo‘ladi.

Vizir chizig‘ini siljitish mumkin, buning uchun chiziqqa kursorni olib borib, sichqonchanning chap tugmasini bosib, uni qo‘yib yubormay kursorni siljiriladi.

Yondagi oynada o‘lchanilayotgan kattaliklarning qiymatlari aks topadi (xususan, X1, Y1- birinchi vizir chizig‘i va xarakteristkaning kesishish nuqtalari chastota va amplitudasi, X2, Y2 lar – ikkinchi vizir chizig‘i va xarakteristkaning kesishish nuqtalari chastota va amplitudasini ko‘rsatadi).

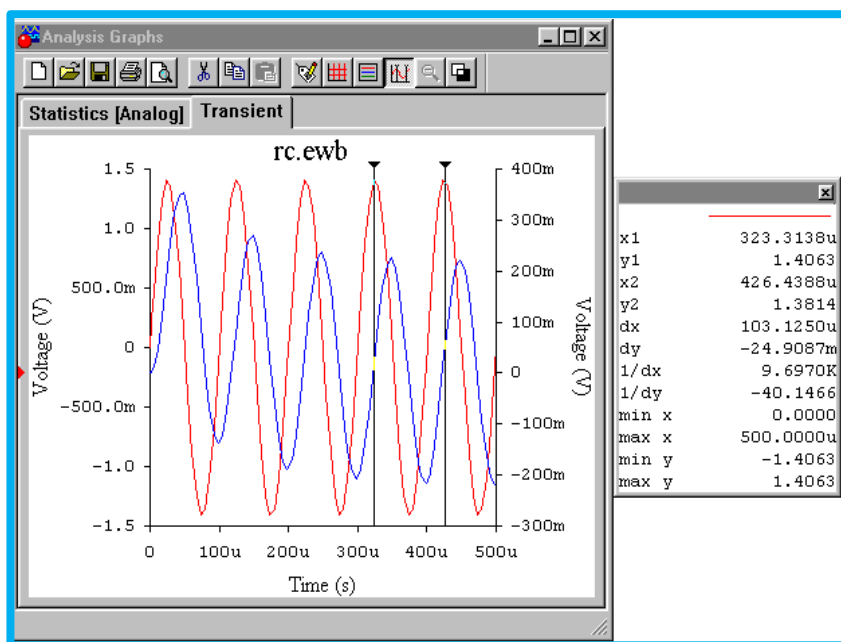


8- rasm. 50 Gs chastota uchun o'lchov natijalari

Har bir chastota uchun kirish (Akir) va chiqish (Achiq) signallari amplitudalari, hamda Δt (chiqish va kirish signallari orasidagi vaqt bo'yicha siljish) kattaliklarini o'lchash kerak. Bu vaqt oralig'i bizga quyidagi formula yordamida faza siljishini aniqlashga yordam beradi:

$$\varphi = \omega \Delta t = 2\pi f \Delta t (\text{radian}). \quad (6)$$

O'tish jarayonlari bir nechta davrlar mobaynida oxiriga yetmaganligi uchun (signallarning faqat doimiy tashkil etuvchisi o'zgaradi) amplituda qiymatlar sifatida tebranishlarning to'la amplituda qiymatlari olinadi (9- rasm).



9- rasm. 10 kGs chastota uchun o'lchov natijalari

Natijalarni 5- jadvalga kirgizing.

5- jadval

	50 Gs	100 kGs
Achiq/Akir				
φ ,grad				

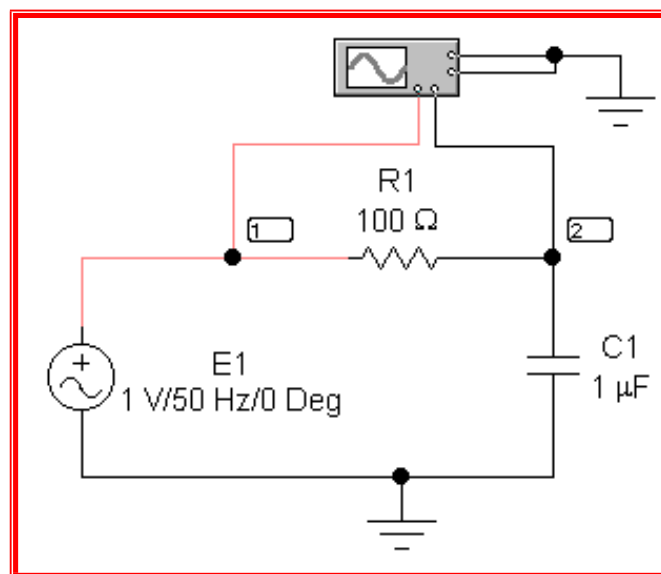
Natijalar tahlili

O'lchov natijalari asosida amplituda-chastota va fazao-chastota xarakteristikalarini chizing.

Bajarish tartibi (3- usul)

Buning uchun 3- rasmda keltirilgan sxemadan foydalaniladi.

1) **O'lchov sxemasini tayyorlash.** Sxemaga ossillograf ulang (10- rasm). Ossillograf kirish simlarining ranglarini har xil qilib oling (mos ravishda ossillogrammalar ham turli ranglarda bo'ladi). Generator parametrlari, qarshilik va sig'imler qiymatlarini 10-rasmda ko'rsatilganday qilib oling.



10- rasm. RC – zanjirni ossillograf yordamida o'rganish sxemasi

2) **O'lchashlar.** Ossillograf old panelini uning tasvirini ikki marta sichqonchanning chap tugmasini bosish bilan chiqaring. Ossillograf old panelidagi quyidagi:

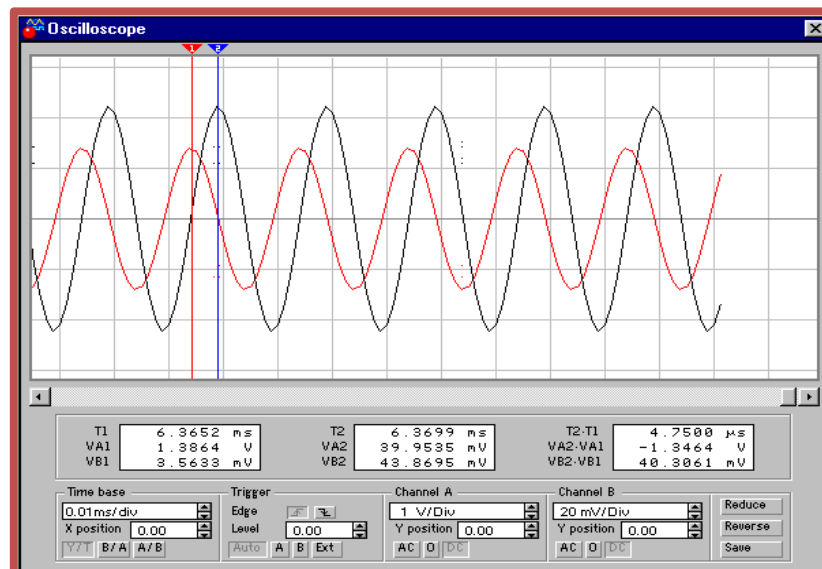
Expand

tugmasini bosing. Ossillograf old panelining kattalashtirilgan tasviri paydo bo‘ladi. Modellastirish rejimini quyidagi tugma yordamida ishga tushiring:



Yoyish davomlilikini (*TimeBase*) va vertikal o‘q (*Channel A*) bo‘yicha masshtabni shunday tanlab olingki, ossillograf ekranida tebranishlarning bir nechta davrlari aks etsin. Vizir chiziqlari yordamida RC – zanjir kirish signali amplitudasi A_{kir} va chiqish signali amplitudasi A_{chiq} larni o‘lchang (11- rasm). Zanjir uzatish koeffitsienti qiymati A_{chiq}/A_{kir} ga teng bo‘ladi. Chiqish va kirish signallari orasidagi vaqt siljishini o‘lchang va faza siljishini yuqoridagi (6) formula bilan hisoblang.

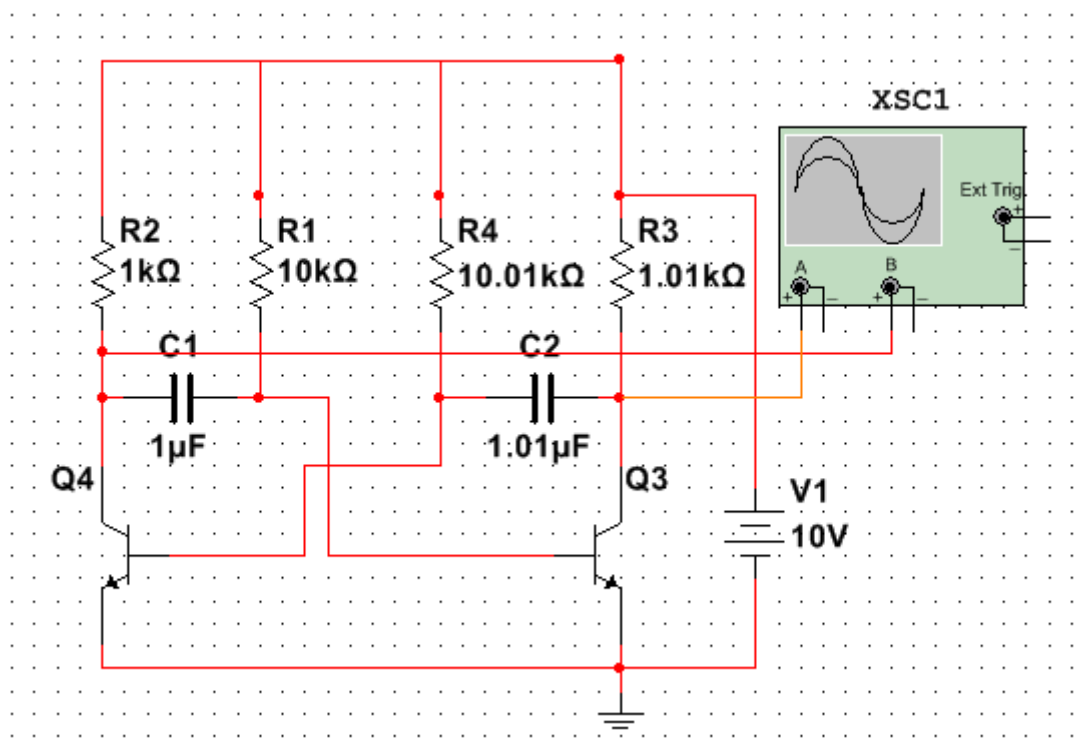
11- rasmda 50 kGs chastota uchun chap vizir chizig‘i yordamida A_{kir} kirish signali amplitudasi A_{kir} ($VA1 = 1.3864$ V), o‘ng vizir chizig‘i yordamida esa chiqish signali amplitudasi A_{chiq} ($VB2 = 43.8695$ mV), uchinchi oynada esa signallar orasidagi siljish ($T2-T1 = 4.7600$ mks) o‘lchanadi. Generator chastotasini o‘zgartirib, amplituda-chastotava faza-chastota xarakteristikalarini oling, natijalarni 6- jadvalga kirgizing.



11- rasm. Signal parametrlarini o‘lchash

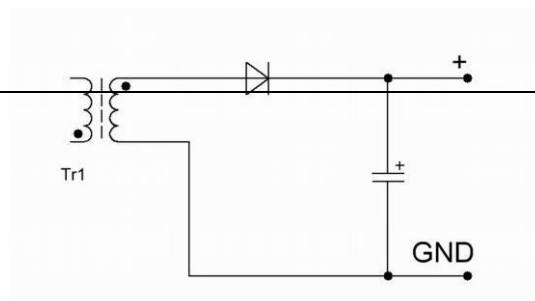
6- jadval

	50 Gs	100 kGs
A_{chiq}/A_{kir}				
ϕ, grad				



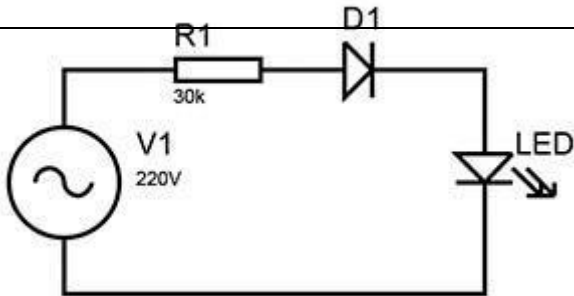
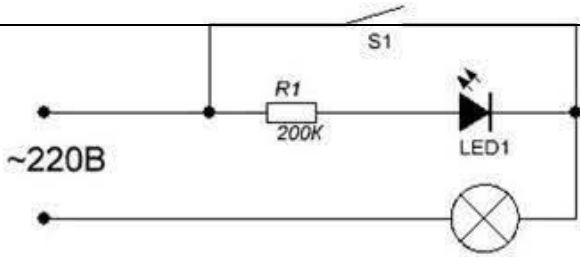
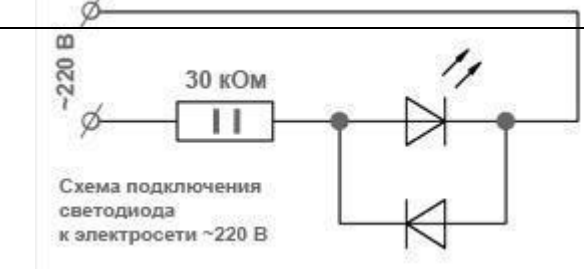
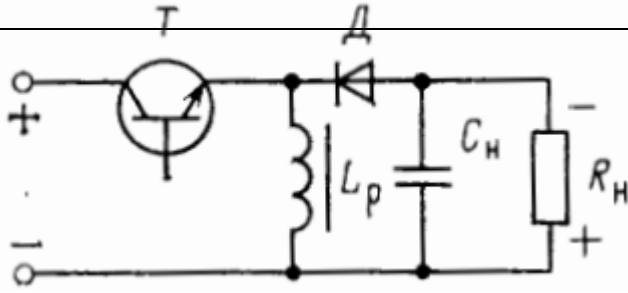
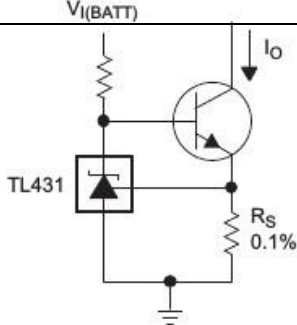
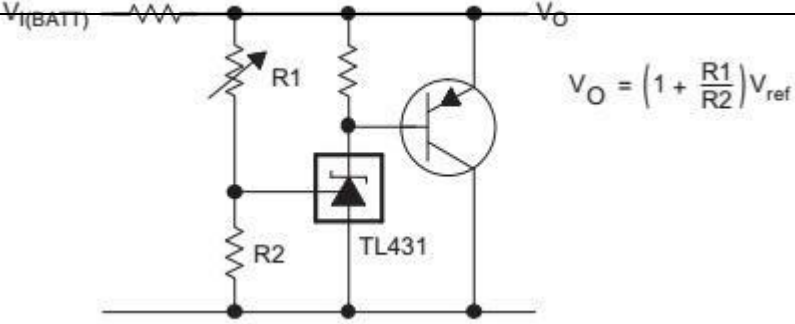
Laboratoriya ishini bajarish bo'yicha topshiriq variantlari

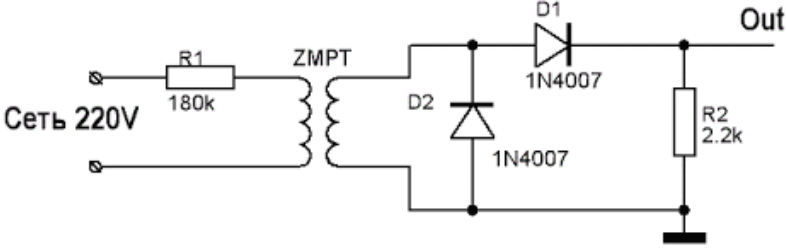
1	
2	
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4	
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6	

7	<p>Понижающий конденсатор</p> <p>220 В</p> <p>electrongrad.ru</p> <p>нагрузка</p>
8	<p>ВХОД</p>
9	<p>R1 240k</p> <p>C1 220n</p> <p>~220V</p> <p>R2 47</p> <p>VD1</p> <p>HL1</p>
10	<p>R1 12k</p> <p>~220V</p> <p>R2 12k</p> <p>HL1</p> <p>HL2</p>
11	<p>R1 220k</p> <p>C1 220n</p> <p>~ 220 В</p> <p>R2 47</p> <p>HL1</p> <p>HL2</p> <p>HL3</p> <p>HL4</p> <p>HL5</p> <p>HL6</p>
12	<p>R1 240k</p> <p>C1 220n</p> <p>~220V</p> <p>R2 47</p> <p>VD1</p> <p>HL1</p>

13	
14	
15	 <p>Схема подключения светодиода к электросети ~220 В</p>
16	
17	 <p style="text-align: right;">$I_O = \frac{V_{ref}}{R_S}$</p>
Figure 29. Precision Constant-Current Sink	
18	 <p style="text-align: right;">$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{ref}$</p>

19	
20	