26-ma`ruza.Om va Kirxgof qonunlarining operator shakli.

Reja

1. Om va Kirxgof qonunlarining operator shakli.
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1.Om va Kirxgof qonunlarining operator shakli.

1.1Kirxgof qonunining operator shaklidagi tasviri.

Zanjir tugunidagi toklar qiymatlarining yig`indisi nolga teng:

$$\sum_{k=1}^{n} i_k = 0.$$

Har qanday tarmoqdagi tok $i_k(t)$

$$\sum_{k=1}^{n} I_k(p) = 0 \qquad (1)$$

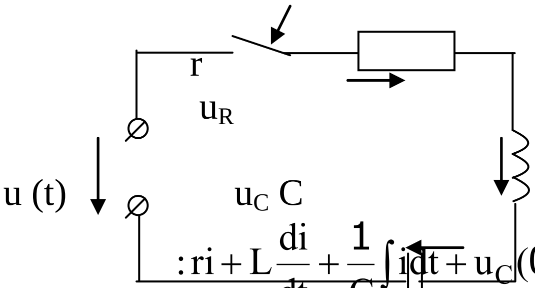
Kirxgofning II-qonuni.

$$\sum_{k=1}^{n} U_k = \sum_{k=1}^{n} e_k.$$

Operator ko`rinishda $\sum_{k=1}^{n} U_k(p) = \sum_{k=1}^{n} E_k(p)$ (2)

(1) va (2) chi Kirxgof qonunlarining operator shaklidagi ifodasi.

1.2.Om qonunining operator shaklidagi tasviri.



$$: ri + L\frac{di}{dt} + \frac{1}{C}\int i dt + u_C(0) = u(t)$$

$$r\int_0^{\infty} i(t)e^{-pt}dt + L\int_0^{\infty} i'(t)e^{-pt}dt + \frac{1}{C}\int_0^{\infty}\left[\int_0^{t} i(t)dt\right]e^{-pt}dt + \int_0^{\infty} u_C(0)e^{-pt}dt = \int_0^{\infty} u(t)e^{-pt}dt.$$

$$rI(p)+pLI(p)-Li(0)+\frac{I(p)}{pC}+\frac{u_C}{p}=u(p).$$

i(t)=I(p) âà u(t)=u(p).

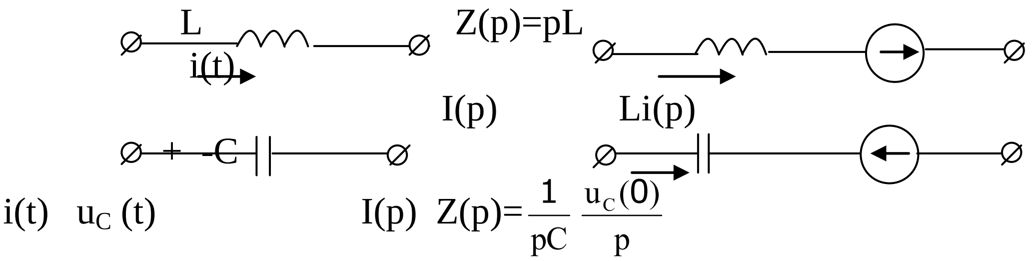
$$I(p)=\frac{u(p)+Li(0)-\dfrac{u_C(0)}{p}}{r+pL+\dfrac{1}{pC}}=\frac{u(p)+Li(0)-\dfrac{u_C(p)}{p}}{Z(p)}$$

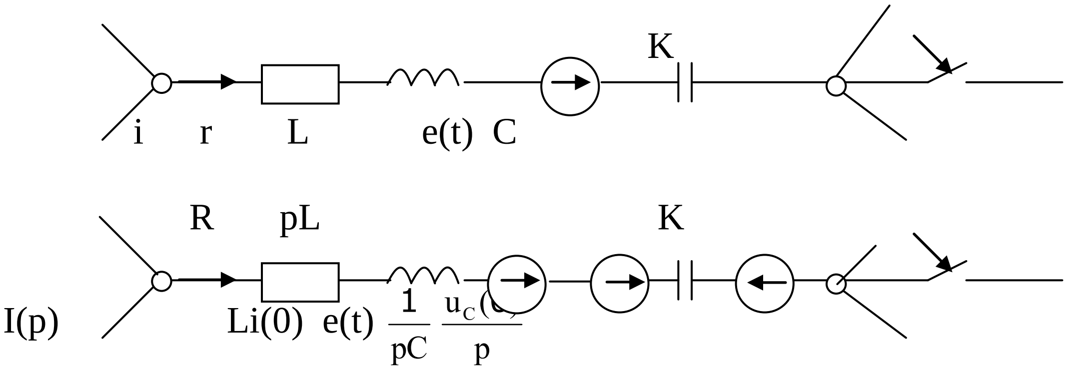
$Z(p)=r+pL+\dfrac{1}{pC}$ - operator qarshilik.

Om qonunining operator shaklidagi ifodasi nolinchi boshlang`ich shartlarda:

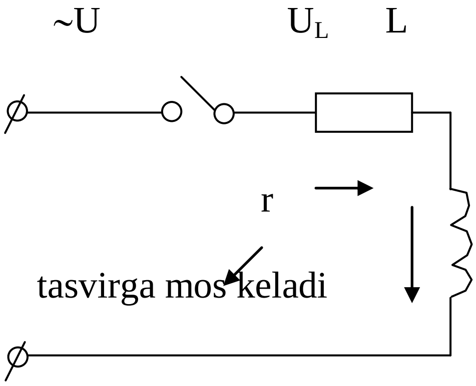
$$I(p)=\frac{u(p)}{z(p)}$$

Operator sxema oldin keltirilgan sinusoidal turg`un xolatga chizilgan sxemadan farq qiladi. Operator ko`rinishda kompleks kattaliklar jωL âà jωC lar pL âà pC ga almashtiriladi.





2.Yoyish Teoremasi



RL zanjirni sinusoidal kuchlanish

U(t) =UmSin(ωt+ψ)

Ulash jadvalga binlan zanjirga berilgan Kuchlanishi u(t) ning funksiyasi quyidagi

tasvirga mos keladi

$$U(p)=Um\frac{pSin\psi+\omega Cos\psi}{p^2+\omega^2}$$

Operator shaklida o`tkinchi tok

$$I(p)=\frac{U(p)}{Z(p)}=Um\frac{pSin\psi+\omega Cos\psi}{(p^2+\omega^2)(r+pL)}=\frac{\frac{Um}{L}(pSin\psi+\omega Cos\psi)}{(p+j\omega)(p-j\omega)(p+\frac{r}{L})} \qquad (1)$$

$$\frac{F_1(p)}{F_2(p)}=\frac{A_1}{p-p_1}+\frac{A_2}{p-p_2}+.....+\frac{A_n}{p-p_n}=\sum_{k=1}^{n}\frac{A_k}{p-p_k}$$

bu yerda: A_1 A_2..An – yeyish koeffisientlarini ifodalovchi oddiy xaqiqiy sonlar,

r_1, r_2..rn – tenglama F_2 (p)=0 ning ildizlari
Koeffisient Ak quyidagicha aniqlanadi.

$$Ak=\frac{F_1(p_k)}{F_2(p_k)}$$

Ko`rib chiqilaetgan misolda tekshirilayotgan operator funksiya quyidagi kasrni ifodalaydi,

$$I(p)=\frac{F_1(p)}{F_2(p)}=\frac{\frac{Um}{L}Sin\psi p+\omega\frac{Um}{L}Cos\psi}{(p+j\omega)(p-j\omega)(p+\frac{r}{L})};$$

Moxraæ $F_2(p)$ ning ildizlari:

$$R_1=-j\omega,\ p_2=j\omega,\ p_3=-\frac{r}{L},$$

Yoyish koeffisientlarini aniqlaymiz:

$$A_1=\frac{\frac{Um}{L}(-j\omega)Sin\psi+\frac{Um\omega}{L}Cos\psi}{(p^3+\frac{r}{L}p^2+\omega^2p+\omega^2\frac{r}{L})^1{}_{[P=-jk]}}=\frac{\frac{Um\omega}{L}(Cos\psi-jSin\psi)}{(3p^2+2\frac{r}{L}p+\omega^2)_{[p-j\omega]}}=-\frac{\frac{Um}{L}\omega e^{-j\psi}}{2\omega^2+j2\omega\frac{r}{L}}=$$

$$=-\frac{Ume^{-j\psi}}{2(\omega L+jr)}=-\frac{Ume^{-j\psi}}{2j(r-j\omega L)}=-\frac{Ume^{j\psi}}{2jze^{-j\varphi}}=-\frac{Ume^{-j(\psi-\varphi)}}{2jZ}$$

$$A_2=\frac{\frac{Um\omega}{L}(Cos\psi+jSin\psi)}{(3p^2+2\frac{r}{L}p+\omega^2)[p=j\omega]}=\frac{\frac{Um\omega}{L}e^{j\psi}}{-2\omega\ \ +2j\omega\frac{r}{L}}=\frac{Ume^{j\psi}}{2j(r+j\omega L)}=\frac{Ume^{j\psi}}{2jZe^{j\varphi}}=\frac{Ume^{j(\psi-\varphi)}}{2jZ}$$

$A_3=$

$$=\frac{\frac{Um}{L}(-\frac{r}{L})Sin\psi+\frac{Um\omega}{L}Cos\psi}{(3p^2+2\frac{r}{L}p+\omega^2)_{\left[p=-\frac{r}{L}\right]}}=-\frac{Um(rSin\psi-\omega LCos\psi)}{L^2(\omega^2+\frac{r^2}{L^2})}=-\frac{Um^2(Sin\psi.Cos\varphi-Cos\psi Sin\varphi)}{Z^2}=$$

$$=-\frac{Um}{Z}Sin(\psi-\varphi).$$

$$I(p)=\frac{F_1(p)}{F_2(p)}=-\frac{Ume^{-j(\psi-\varphi)}}{2jZ(p+j\omega)}+\frac{Ume^{j(\psi-\varphi)}}{2jZ(p-j\omega)}-\frac{UmSin(\psi-\varphi)}{Z(p+\frac{r}{L})}.$$

Jadval asosida oddiy kasrlar yig\`indisining xar bir tashkil etuvchisiga mos originalini tanlaymiz:

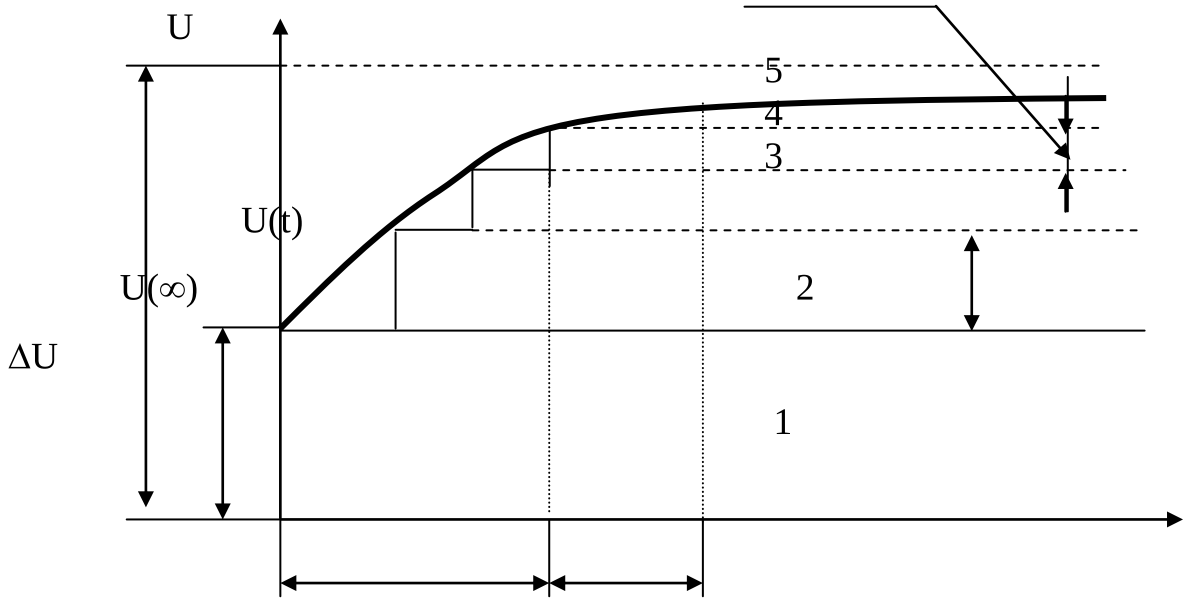
$$i(t)=\frac{Ume^{-j(\psi-\varphi)}e^{-j\omega t}}{2jZ}+\frac{Ume^{j(\psi-\varphi)}e^{j\omega t}}{2jZ}-\frac{Um}{Z}Sin(\psi-\varphi)e^{-\frac{r}{L}t}=$$

$$=\frac{Um}{Z}\frac{e^{j(\omega t+\psi-\varphi)}-e^{-j(\omega t+\psi-\varphi)}}{2j}-$$

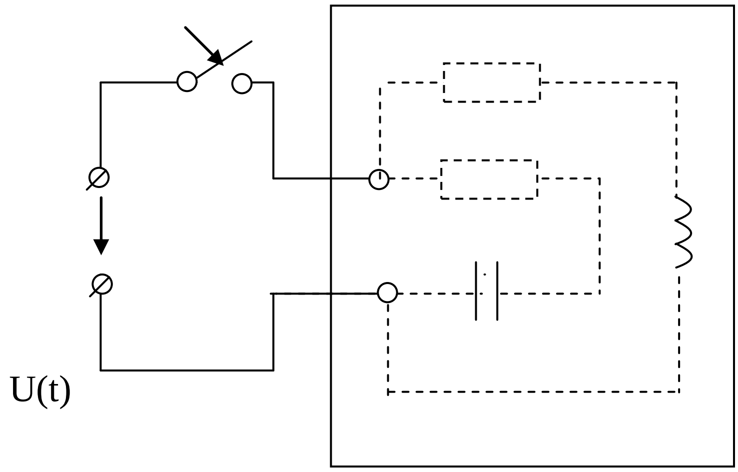
$$-\frac{Um}{Z}Sin(\psi-\varphi)e^{-\frac{r}{L}t}=\frac{Um}{Z}\left[Sin(\omega t+\psi-\varphi)-Sin(\psi-\varphi)e^{-\frac{r}{L}t}\right]$$

3.Dyuamel integrali.

$$\Delta U=\frac{\Delta U}{\Delta X}\Delta X$$



Passiv zanjirlarni o`zgarmas yoki sinusoidal kuchlanishga ulaganda bo`ladigan o`tkinchi jarayonlarni qisoblash nisbatan oddiy, chunki kommutatsiyadan keyin turg`unlashgan va erkin tok va kuchlanishlar oddiy qamda yaxshi o`rganilgan qonunlar bo`yicha o`zgaradi. Lekin manbaning kuchlanishi vaqt jixatidan ix
tiyoriy qonunga ko`ra o`zgarsa masala birmuncha murakkablashadi.



Zanjir t=0 da U_0. U_0 o`zgarmas kuchlanishdan iste'mol qilinadigan o`tkinchi tok shu kuchlanish U_0 ni o`tkinchi o`tkazuvchanlik deb ataladigan Y(t) .

$$i(t)=U_0Y(t)$$

Y(t) âà U_0. Unda ketma-ket ulangan elementlar uchun:

$$i(t) = U_O Y(t) = U_O \frac{1}{r}(1 - e^{-\frac{t}{\tau}})$$

Tokning o`zgarish qonuni o`tkinchi o`tkazuvchanlikning o`rganish qonunida aks etiladi:

$$Y(t) = \frac{1}{r}(1 - e^{-\frac{r}{L}t})$$

Kuchlanish U_0 ni yagona 1V ga teng impuls bilan almashtirsak:

$$i(t)=1\cdot Y(t)= Y(t)$$

Y(t) istalgan vaqt paytida o`tkinchi tok i(t) ning oniy qiymati son jiqatidan aniqlaydi. Zanjir ΔU impulsga ulashdagi o`tkinchi jarayonni vaqt jixatdan bir qancha mikroprotsesslarga yoyamiz. Kuchlanish U(0) ning birinchi sakrashi o`tkinchi tok i(t) ning U(0)·Y(t) tashkil etuvchisini beradi. ΔX vaqtdan so`ng ΔU sakrash bo`lib, o`tkinchi tok ΔU·Y(t-ΔX). X vaqtdan so`ng o`tkinchi tokda

$$Y(t-\Delta X)\frac{\Delta U}{\Delta X}\Delta X$$

sakrash bo`ladi va q.k. t→∞. Kuchlanish U(t) ning ta'siri quyidagi o`tkinchi tok bilan ifodalanadi:

$$i(t) \cong U(0)Y(t) + \sum_{X=O}^{k=t} Y(t - X)\frac{\Delta U}{\Delta X}\Delta X \qquad (1)$$

ΔU va ΔX ortirma qanchalik kichik bo`lsa, o`tkinchi jarayonning xaqiqiy manzarasi shuncha aniq bo`ladi, ΔX→0 bo`lsa:

$$U'(X)= \lim_{\Delta X \to 0} \frac{\Delta U}{\Delta X} = \left(\frac{dU}{dt}\right)_{t=x}$$

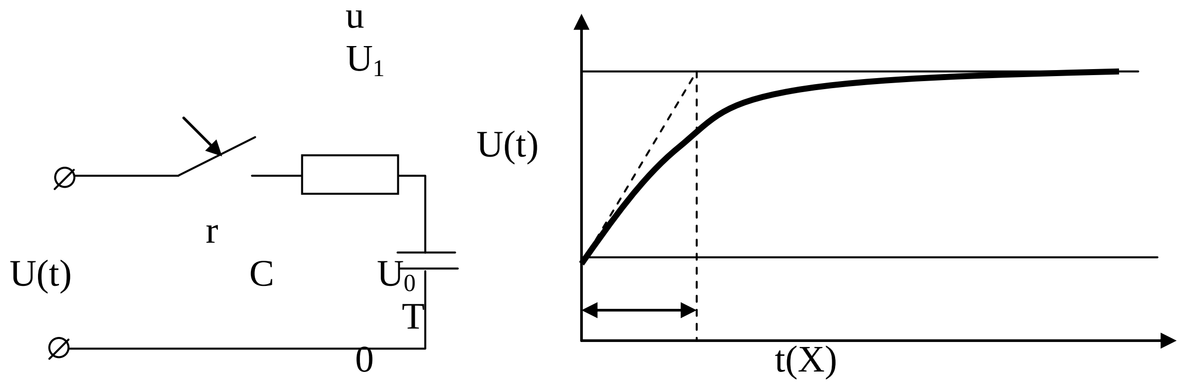
$$i(t) = U(0)Y(t) + \int_0^t Y(t - X) \cdot U'(X)dX \qquad (2)$$

Dyuamel integrali yordamida o`tkinchi jarayonlarini hisoblash.

Misol. Berilgan: $U(t)=U_1-(U_1-U_0)e^{-\frac{t}{T}}$

U_0=100 â; U_1=220 v; T=0,02 sek; r=10^3 Îì; S=80 mkf.

i(t)-?



$$Y(t) = \frac{1}{r} e^{-\frac{t}{T}} = 10^{-3} e^{-12,5t} \left[\frac{1}{Om}\right]; \quad \tau = rC = 0,08.$$

$$U(t) = U_1 - (U_1 - U_0) e^{-\frac{t}{\tau}}$$

$$U(x) = U_1 - (U_1 - U_0) e^{-\frac{t}{T}} = 220 - 120 e^{-50x};$$

$$i(t) = U(0)Y(t) + \int_0^t Y(t-x)U'(x)dx = U_0 \frac{1}{r} e^{-\frac{t}{\tau}} + \int_0^t \frac{1}{r} e^{-\frac{t-x}{\tau}} \times \frac{U_1 - U_0}{T} e^{-\frac{x}{T}} dx =$$

$$\frac{U_0}{r} e^{-\frac{t}{\tau}} + \frac{U_1 - U_0}{rT} e^{\frac{t}{\tau}} \int_0^t e^{-\left(\frac{1}{T} - \frac{1}{\tau}\right)} dx = \frac{U_0}{r} e^{-\frac{t}{\tau}} - \frac{(U_1 - U_0)\tau}{r(\tau - T)} e^{-\frac{t}{\tau}} \left[e^{-\frac{t}{T}} \cdot e^{\frac{t}{\tau}} \right] =$$

$$\frac{U_0}{r} e^{-\frac{t}{\tau}} + \frac{(U_1 - U_0)}{r(\tau - T)} e^{-\frac{t}{\tau}} - \frac{(U_1 - U_0)\tau}{r(\tau - T)} e^{-\frac{t}{T}} = 0,1 e^{-12,5t} + \frac{120 \cdot 0,08}{10^3 \cdot 0,06} e^{-12,5t} -$$

$$- \frac{120 \cdot 0,08}{10^3 \cdot 0,06} e^{-50t} = 0,26 e^{-12,5t} - 0,16 e^{-50t} \qquad (A)$$

zanjirni ulash paytida iste’mol qilanayotgan tok maksimal bo`ladi:

$$i(0) = 0,26 - 0,16 = 0,1 \text{ A}$$

$$i(\infty) = 0$$

Sinov savollari.

1. Yoyish teoremasi qanday xollarda qo`llaniladi?
2. r ,C zanjirni qisqa tutashtirish xolati operator usulda qanday qisoblanadi?
3. r L zanjirga kondensatorning aperiodik zaryadsizlanishi operator usulida xisoblash?