

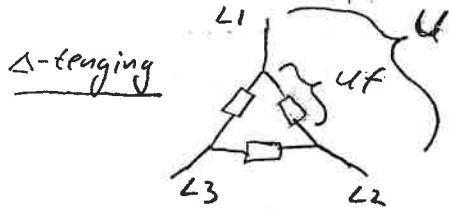
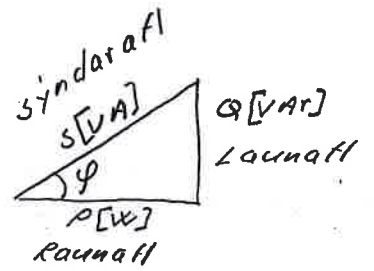
Raunaflið: $P = \sqrt{3} \cdot U \cdot I \cdot \cos\phi$ [W]

Launaflið: $Q = \sqrt{3} \cdot U \cdot I \cdot \sin\phi$ [VA_r]

Sýndaraflið: $S = \sqrt{3} \cdot U \cdot I$ [VA]

$Q = \sqrt{S^2 - P^2}$

} Þriggja fasa.
Ef eintasa
⇒ sleppa $\sqrt{3}$



$\Delta U = \Delta U_f$
 $\Delta I = \Delta I_f \cdot \sqrt{3}$



$Y U = Y U_f \cdot \sqrt{3}$
 $Y I = Y I_f$

Síur og sveiflurásir:

$$U = R \cdot I \quad S = U \cdot I \quad P = u \cdot i \cdot \cos \phi = i^2 \cdot R = \frac{u^2}{R} \quad Z = \frac{u}{i}$$

$$X_L = 2\pi \cdot f \cdot L \quad X_C = \frac{1}{2\pi \cdot f \cdot C} \quad \omega = 2\pi \cdot f$$

$$Z_{rad} = \sqrt{R^2 + (X_L - X_C)^2} \quad Z_{rad} = \sqrt{R^2 + X^2} \quad \phi_{rad} = \tan^{-1} \left(\frac{X}{R} \right)$$

$$Z_{hlið} = \frac{R \cdot X}{\sqrt{R^2 + X^2}} \quad i_g = \frac{u_g}{Z} \quad \phi_{hlið} = \tan^{-1} \left(\frac{R}{X} \right)$$

$$Z_{rad} = \sqrt{2} \cdot R \quad Z_{hlið} = \frac{R}{\sqrt{2}} \quad \leftarrow \text{ (gildir um síur við marktiðni)}$$

$$f_0 = \frac{1}{2\pi \cdot R \cdot C} \quad f_0 = \frac{R}{2\pi \cdot L} \quad \leftarrow \text{ (gildir um síur við marktiðni)}$$

$$f_r = \frac{1}{2\pi \cdot \sqrt{L \cdot C}} \quad X_L = X_C = \sqrt{\frac{L}{C}} \quad \text{(gildir um sveiflurásir við resónans (eigintíðni))}$$

$$Q = \frac{u_L}{u_r} = \frac{i \cdot X_L}{i \cdot R_W} = \frac{X_L}{R_W} \quad BW = \frac{f_r}{Q} \quad k = \frac{1}{Q}$$

(Gæðastuðull)

(Bandbreidd)

$$Z_{rad} = R_W = \frac{X_L}{Q} = \frac{X_C}{Q} \quad Z_{hlið} = R = R_W (1 + Q^2) \approx R_W \cdot Q^2 = X \cdot Q = \frac{L}{C \cdot R_W} = \frac{X_L^2}{R_W}$$

(Raðtenging LC-rás)

(Hliðtenging LC-rás)

$$\tau = R \cdot C = \frac{L}{R} \quad u_C = U \cdot (1 - e^{-t/RC}) \quad u_C = U \cdot (e^{-t/RC})$$

(Tímastuðull)

(Upphleðsla)

(Afhleðsla) \leftarrow (gildir um þetta)

$$C = \frac{Q}{U} = \frac{I \cdot t}{U} \quad W = \frac{1}{2} C U^2 \quad W = \frac{1}{2} L I^2$$

(C=rýmd þéttis, eining Farad [F]
Q=hleðsla, eining Coulomb [C] !!)

(W=orka, vinna, eining Joule [J]
P = afl, eining [W] !!!)

Mögnun:

$$A_p [dB] = 10 \cdot \log \left(\frac{P_2}{P_1} \right) \quad A_p [dB] = 10 \cdot \log (A_p) \quad A_p = 10^{(A_p [dB] / 10)}$$

$$A_u [dB] = 20 \cdot \log \left(\frac{u_2}{u_1} \right) \quad A_u [dB] = 20 \cdot \log (A_u) \quad A_u = 10^{(A_u [dB] / 20)}$$

$$A_i [dB] = 20 \cdot \log \left(\frac{i_2}{i_1} \right) \quad A_i [dB] = 20 \cdot \log (A_i) \quad A_i = 10^{(A_i [dB] / 20)}$$

ATHUGIÐ:
Sumir hafa stundum þá venju að nota bókstafinn **G** fyrir [dB] mögnun og **A** fyrir "sinnum" mögnun.

Thevenin og Norton:

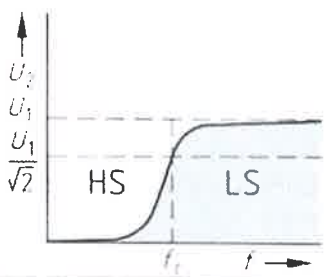
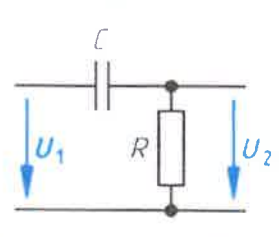
$$U_{TH} = E \left(\frac{kR}{kR + (1-k)R} \right) \quad R_{TH} = kR // (1-k)R \quad \leftarrow \text{ (gildir um stilliviðnám, } k = \text{staða miðúttaks (} 0 \leq k \leq 1 \text{))}$$

$$U_{TH} = \frac{U_1 R_1 - U_2 R_2}{R_1 + R_2} \quad R_{TH} = R_1 // R_2 \quad \leftarrow \text{ (gildir um tvo spennugjafa, tvö viðnám)}$$

$$t = \frac{Q}{I} \quad [h] = \frac{[Ah]}{[A]} \quad \leftarrow \text{ (gildir um batterí)}$$

9.8 Há- og lágtíðnisúr (Lág- og háhleyphisúr)

RC-lágtíðnisía

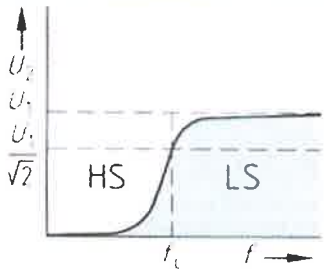
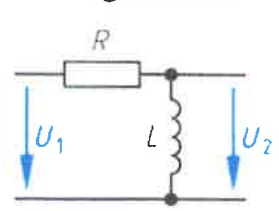


- U_1 inngangsspenna
- U_2 útgangsspenna
- R viðnám
- C rýmd
- f_c marktíðni
- ω hornhraði
- HS hindrunarsvæði
- LS leiðnisvæði

$$\frac{U_2}{U_1} = \frac{R}{\sqrt{R^2 + \left(\frac{1}{\omega \cdot C}\right)^2}}$$

$$f_c = \frac{1}{2\pi \cdot R \cdot C}$$

RL-lágtíðnisía

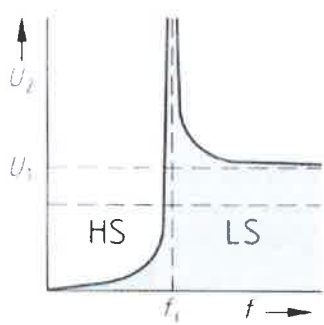
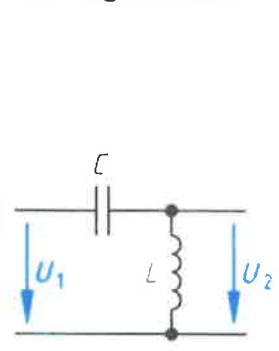


- U_1 inngangsspenna
- U_2 útgangsspenna
- R viðnám
- L span
- f_c marktíðni
- ω hornhraði
- HS hindrunarsvæði
- LS leiðnisvæði

$$\frac{U_2}{U_1} = \frac{1}{\sqrt{\left(\frac{R}{\omega \cdot L}\right)^2 + 1}}$$

$$f_c = \frac{R}{2\pi \cdot L}$$

LC-lágtíðnisía



- U_1 inngangsspenna
- U_2 útgangsspenna
- C rýmd
- L span
- f_c marktíðni
- ω hornhraði
- HS hindrunarsvæði
- LS leiðnisvæði

$$f_c = \frac{1}{2\pi \sqrt{L \cdot C}}$$

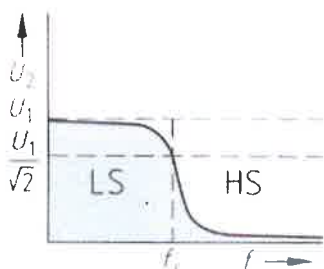
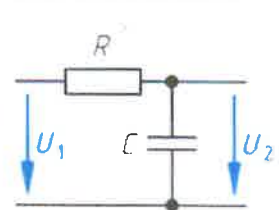
Pegar $X_L > X_C$:

$$\frac{U_2}{U_1} = \frac{1}{1 - \frac{1}{\omega^2 \cdot L \cdot C}}$$

Pegar $X_L < X_C$:

$$\frac{U_2}{U_1} = \frac{1}{\frac{1}{\omega^2 \cdot L \cdot C} - 1}$$

RC-hátíðnisía

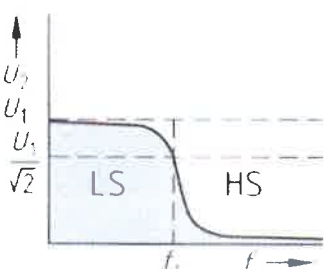
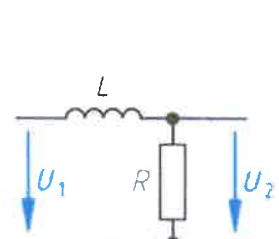


- U_1 inngangsspenna
- U_2 útgangsspenna
- R viðnám
- C rýmd
- f_c marktíðni
- ω hornhraði
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$$\frac{U_2}{U_1} = \frac{1}{\sqrt{1 + (\omega \cdot R \cdot C)^2}}$$

$$f_c = \frac{1}{2\pi \cdot R \cdot C}$$

RL-hátíðnisía

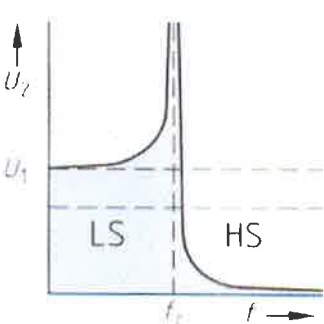
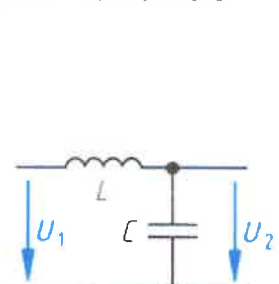


- U_1 inngangsspenna
- U_2 útgangsspenna
- R viðnám
- L span
- f_c marktíðni
- ω hornhraði
- HS hindrunarsvæði
- LS leiðnisvæði

$$\frac{U_2}{U_1} = \frac{1}{\sqrt{1 + \left(\frac{\omega \cdot L}{R}\right)^2}}$$

$$f_c = \frac{R}{2\pi \cdot L}$$

LC-hátíðnisía



- U_1 inngangsspenna
- U_2 útgangsspenna
- C rýmd
- L span
- f_c marktíðni
- ω hornhraði
- HS hindrunarsvæði
- LS leiðnisvæði

$$f_c = \frac{1}{2\pi \sqrt{L \cdot C}}$$

Pegar $X_L > X_C$:

$$\frac{U_2}{U_1} = \frac{1}{\omega^2 \cdot L \cdot C - 1}$$

Pegar $X_L < X_C$:

FORMÚLA	FORMÚLUTEXTI		
$I = \frac{Q}{t}$	Stráumur / rafhleðsla	$\epsilon_r = \frac{\epsilon}{\epsilon_0}$	Hlutfallslegur rafsvörunarstuðull
$U = R \cdot I$	Lögmál Ohms	$C = \epsilon \cdot \frac{A}{l}$	Rýmd þéttis
$R = R_1 + R_2 + R_3 + \dots$	Raðtenging mótstaðna	$Q = C \cdot U$	Rafhleðsla
$U = U_1 + U_2 + U_3 + \dots$	2. lögmál Kirchhoffs (hlutspennur)	$\tau = R \cdot C$	Tímastuðull, RC - liður
$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$	Hliðtenging mótstaðna	$C = C_1 + C_2 + C_3 + \dots$	Hliðtenging þétta
$R = \frac{R_1 \cdot R_2}{R_1 + R_2}$	Hliðtenging mótstaðna	$Q = Q_{C1} + Q_{C2} + Q_{C3} + \dots$	Hleðsla þétta í hliðtengingu
$I = I_1 + I_2 + I_3 + \dots$	1. lögmál Kirchhoffs (greinistraumar)	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$	Raðtenging þétta
$R_x = \frac{R_3}{R_4} \cdot R_2$	Mælifbrú Wheatstones	$Q = Q_{C1} = Q_{C2} = Q_{C3} = \dots$	Hleðsla þétta í raðtengingu
$R_t = \frac{\rho \cdot l}{A}$	Viðnám leiðara	$F = B \cdot I \cdot l$	Kraftur á straumfara leiðara í segulsviði
$U_t = I \cdot \frac{\rho \cdot l}{A}$	Spennufall í leiðara	$F_m = I \cdot N$	Ampervafningatala / segulspenna / íseglun
$R_2 = R_1 + R_1 \cdot \alpha (t_2 - t_1)$	Viðnámsbreyting vegna hitabreytinga	$H = \frac{I \cdot N}{l}$	Segulsviðsstyrkur
$G = \frac{1}{R}$	Rafleiðni	$\mu_r = \frac{\mu}{\mu_0}$	Hlutfallsleg segulleiðni
$\gamma = \frac{1}{\rho}$	Eðlisleiðni	$B = \mu \cdot \frac{I \cdot N}{l}$	Segulflæðiþéttleiki / segulþykki
$I_k = \frac{E}{R_k}$	Skammhlaupsstraumur spennugjafa	$R_m = \frac{l}{\mu \cdot A}$	Segulviðnám
$E = U_p + U_i$	2. lögmál Ohms (íspenna, klemmuspenna, innra viðnám)	$e = B \cdot l \cdot v$	Spönuð spenna
$U_i = I \cdot R_i$	Innra spennufall spennugjafa	$L = \mu \frac{N^2 \cdot A}{l}$	Spanstuðull
$U_p = E - I \cdot R_i$	Skautspenna spennugjafa (klemmuspenna)	$L = L_1 + L_2 + L_3 + \dots$	Spanstuðull raðtengdra spóla
$E = E_1 + E_2 + E_3 + \dots$	Raðtenging spennugjafa	$\frac{1}{L} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \dots$	Spanstuðull hliðtengdra spóla
$R_i = R_{i1} + R_{i2} + R_{i3} + \dots$	Innra viðnám raðtengdra spennugjafa	$\tau = \frac{L}{R}$	Tímastuðull RL - liðs
$E = E_b$	Hliðtenging spennugjafa	$f = \frac{1}{T}$	Tíðni
$R_i = \frac{R_m}{n}$	Innra viðnám hliðtengdra spennugjafa	$T = \frac{1}{f}$	Ríðtími / umferðartími
$W = U \cdot I \cdot t$	Orkulögmálið, lögmál Joules	$\lambda = v \cdot T$	Bylgjulengd
$P = \frac{W}{t}$	Rafafi	$U_{med} = 0,637 \cdot U_t$	Reiknað meðalgildi (hálf sínuskúrfa)
$P = U \cdot I$	Afl-lögmálið	$\omega = 2\pi \cdot f$	Horntíðni
$R_y = R_i$	Afl-aðlögun	$S_2 \approx S_1$	Sýndarafli
$\eta = \frac{P_2}{P_1}$	Nýtni	$U_2 = U_1 \frac{N_2}{N_1}$	Spenna
$W = c \cdot m (t_2 - t_1)$	Varmaorka	$I_2 = I_1 \frac{N_1}{N_2}$	Straumur
$J = \frac{I}{A}$	Straumþéttleiki		
$Q_J = \sqrt{S}$	Kjarnaflatarmál [cm ²], [VA]		
$N_P = \frac{U_P}{4,44 \cdot B \cdot A \cdot f}$	Vindingafjöldi [V], [Wb], [m ²], [Hz]		

Athugið: Hæfilegt er að hafa $B = 1,2 \text{ Wb}$
og að $1 \text{ m}^2 = 10.000 \text{ cm}^2$

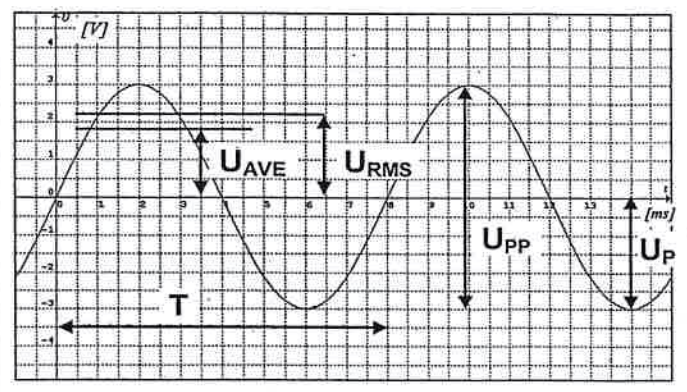
$i = I_i \cdot \sin \omega t$	Augnabliksgildi ríðstraums
$u = U_i \cdot \sin \omega t$	Augnabliksgildi ríðspennu
$U = \frac{U_i}{\sqrt{2}}$	Virkt gildi ríðspennu
$I = \frac{I_i}{\sqrt{2}}$	Virkt gildi ríðstraums
$P = U \cdot I$	Virkt afl (meðalgildi)
$X = 2\pi \cdot f \cdot L$	Spanviðnám
$Z = \frac{U}{I}$	Samviðnám / sýndarviðnám
$U = Z \cdot I$	Lögmál Ohms fyrir ríðstraum
$X_C = \frac{1}{2\pi \cdot f \cdot C}$	Rýmdarviðnám
$Q = U \cdot I \cdot \sin \varphi$	Launafl
$P = U \cdot I \cdot \cos \varphi$	Raunafl
$S = U \cdot I$	Sýndarafl
$\eta = \frac{P_2}{P_1}$	Nýtni
$f_g = \frac{1}{2\pi RC}$	Marktfíðni
$f = \frac{1}{2\pi \sqrt{L \cdot C}}$	Eigintíðni

Rafsvörun lofttæmis: $\epsilon_0 = 8,854 \times 10^{-12}$ F/m
 Segulleiðni lofttæmis: $\mu_0 = 1,256 \times 10^{-6}$ H/m
 Ljós hraði í lofttæmi: $c = 299.792.458$ m/s
 Nota má $c = 3 \times 10^8$ m/s (alveg nægilega nákvæmt)

Segulleiðni, rafsvörun og ljóshraði tengjast þannig:

$$c = \frac{1}{\sqrt{\mu_0 \cdot \epsilon_0}}$$

- $U_{max} = U_P = U_T$ (þrjú nöfn á sömu spennu)
- $U_{eff} = U_{rms} = U_{virk}$ (þrjú nöfn á sömu spennu)
- $U_{ave} = U_{avg} = U_{með}$ (þrjú nöfn á sömu spennu)
- $U_{PP} = 2 \cdot U_P = 2 \cdot U_{max}$
- $U_{max} = U_{PP}/2 = 1,414 \cdot U_{eff} = \sqrt{2} \cdot U_{eff} = 1,57 \cdot U_{með}$
- $U_{eff} = U_{max}/\sqrt{2} = 0,707 \cdot U_{max} = 1,11 \cdot U_{með}$
- $U_{með} = 2 \cdot U_{max}/\pi = 0,637 \cdot U_{max} = 0,90 \cdot U_{eff}$
- Bylgjutími (lotutími) = T tíðni = $f = 1/T$



$Z = U/I$	$Z = \sqrt{R^2 + X^2}$	(samviðnám)
$R = Z \cdot \cos \varphi$	$R = \sqrt{Z^2 - X^2}$	(raunviðnám)
$X = Z \cdot \sin \varphi$	$X = \sqrt{Z^2 - R^2}$	(launviðnám)
$Z = \sqrt{R^2 + (X_L - X_C)^2}$		(samviðnám) (sýndarviðnám)
$R = \sqrt{Z^2 - (X_L - X_C)^2}$		(raunviðnám)
$X = \sqrt{Z^2 - R^2}$		(launviðnám)
$X = X_L - X_C$		(launviðnám, spanviðnám, rýmdarviðnám)

$S = U \cdot I$	$S = \sqrt{P^2 + Q^2}$	(sýndarafl) [VA]
$P = S \cdot \cos \varphi$	$P = \sqrt{S^2 - Q^2}$	(raunafl) [W]
$Q = S \cdot \sin \varphi$	$Q = \sqrt{S^2 - P^2}$	(launafl) [VAr]
$S = \sqrt{P^2 + (Q_L - Q_C)^2}$		(sýndarafl)
$P = \sqrt{S^2 - (Q_L - Q_C)^2}$		(raunafl)
$Q = \sqrt{S^2 - P^2}$		(launafl)
$Q = Q_L - Q_C$		(launafl, span-launafl, rýmdar-launafl)

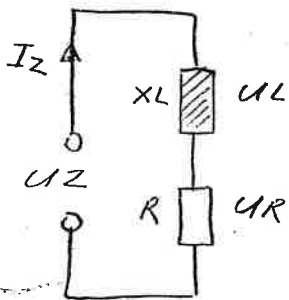
Spöla + raunviðnám
Raðtenging

$$U_Z = \sqrt{U_R^2 + U_L^2}$$

$$Z = \sqrt{R^2 + X_L^2}$$

$$I_Z = \frac{U_Z}{Z}$$

$$\cos \varphi = \frac{U_R}{U_Z}$$



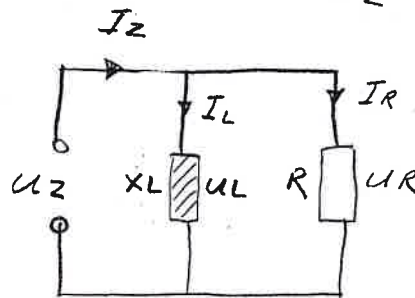
Spöla + raunviðnám
Hliðtenging

$$I_Z = \sqrt{I_R^2 + I_L^2}$$

$$Z = \frac{U_Z}{I_Z}$$

$$I_R = \frac{U_R}{R} \quad I_L = \frac{U_L}{X_L}$$

$$\cos \varphi = \frac{I_R}{I_Z}$$



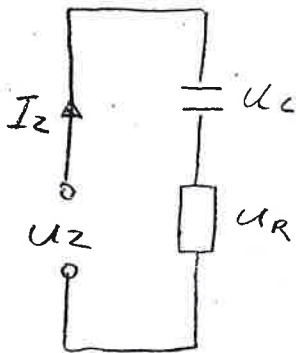
Þéttir + raunviðnám
Raðtenging

$$Z = \sqrt{R^2 + X_C^2}$$

$$I_Z = \frac{U_Z}{Z}$$

$$U_Z = \sqrt{U_R^2 + U_C^2}$$

$$\cos \varphi = \frac{U_R}{U_Z}$$



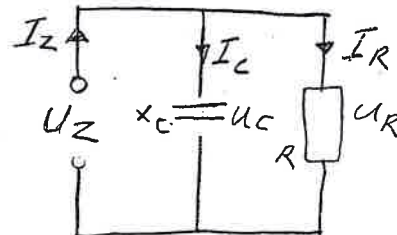
Þéttir - raunviðnám
Hliðtenging

$$I_Z = \sqrt{I_R^2 + I_C^2}$$

$$Z = \frac{U_Z}{I_Z}$$

$$I_R = \frac{U_R}{R} \quad I_C = \frac{U_C}{X_C}$$

$$\cos \varphi = \frac{I_R}{I_Z}$$



Viðnám:

$$X_C = \frac{1}{2 \cdot \pi \cdot f \cdot C}$$

$$X_L = 2 \cdot \pi \cdot f \cdot L$$

X_C = Launviðnám þéttis
 X_L = Launviðnám spölu
 R = Raunviðnám

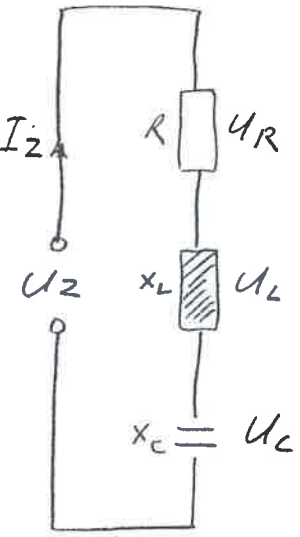
Eigintíðni:

Eigintíðni er þegar $X_L = X_C$

$$f = \sqrt{\frac{1}{4 \cdot \pi^2 \cdot L \cdot C}}$$

Raunviðnám + spóla + þéttir
Rafstenging.

Raunviðnám + spóla + þéttir
Hliðstenging.

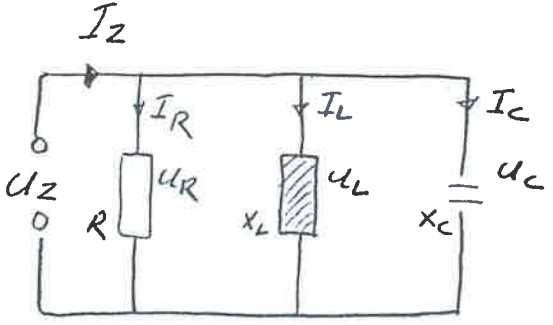


$$Z = \sqrt{R^2 + (x_L - x_C)^2}$$

$$U_Z = \sqrt{U_R^2 + (U_L - U_C)^2}$$

$$P = U \cdot I \cdot \cos \varphi$$

$$\cos \varphi = \frac{U_R}{U_Z}$$

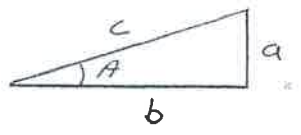


$$I_Z = \sqrt{I_R^2 + (I_C - I_L)^2}$$

$$Z = \frac{U_Z}{I_Z}$$

$$\cos \varphi = \frac{I_R}{I_Z}$$

$$P = U \cdot I \cdot \cos \varphi$$



$$\sin A = \frac{a}{c}$$

$$\cos A = \frac{b}{c}$$

$$\tan A = \frac{a}{b}$$

$$c^2 = a^2 + b^2$$

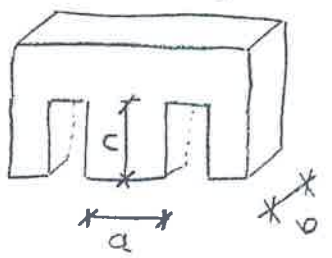
Virsverleiki á forvati:

$$A = \frac{I}{J}$$

A = þverflataformál
J = 2,8 = straum þéttleiki

Spennar:

Stráumur á forvati:



$$I = \frac{S}{U}$$

All sem hægt er að yfirtæra

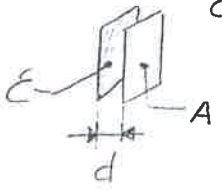
$$S = \text{syndaraff}$$

$$V_K = a \cdot b \cdot c$$

$$dW = \frac{a}{\lambda}$$

$$S = \frac{V_K \cdot dW}{0,8}$$

ϵ_0 = ratsvari loftloemis
 ϵ_r = ratsvari efnis



d = fjarlægð milli plötanna
A = Flataarmál plötanna

$$C = \frac{\epsilon_r \cdot \epsilon_0 \cdot A}{d}$$

Taplous spennir:

$$\frac{U_1}{U_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$