SEE 035 tenta 3/1 2023 korta lösningar

① a) $Z_2 = R_2 = |Z_1| \approx \underline{\underline{180\ \Omega}}$

om Z_2 kan väljas fritt $\Rightarrow Z_2 = \overline{Z_1} \Rightarrow$

strömmen ökar $\Rightarrow$ effekten i R_2 ökar.

b) Gauss lagar $\Rightarrow$ $\Phi_E = q_{innesluten} = -2\,nC$ negativ $\Downarrow$ flöde in i området

$\Phi_M = 0$ (alltid)

c) Slew rate & FB-produkt begränsar f_{max}:

$SR > \left|\frac{du_{ut}}{dt}\right|_{max} = 2\pi\, f_{max} \cdot |A_u| \cdot \hat{u}_{in}$

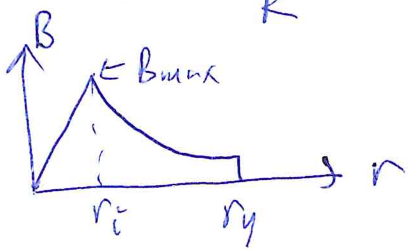
$\Rightarrow \quad f_{max} < 127\ kHz$

$FB > |A_u| \cdot f_{max} \Rightarrow f_{max} < 60\ kHz$

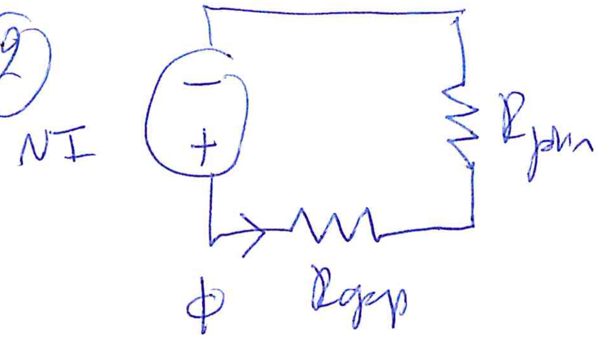
$\therefore \quad f_{max} < \underline{60\ kHz}$

d) $B_{max} = \frac{\mu_0 I}{2\pi r_i}$ där $I = \sqrt{\frac{S \cdot 2\pi r_y^2 \cdot \ln\left(\frac{r_y}{r_i}\right)}{R}} \approx 0{,}42306\ A$

$\approx 1{,}061 \cdot 10^{-4}\ T$



(2)



$$\left.\begin{array}{l} B_{gap} = \dfrac{\Phi}{A} \\ NI = R_{tot} \cdot \Phi \end{array}\right\} \Rightarrow B_{gap} = \frac{NI}{A \cdot R_{tot}}$$

$$R_{tot} = R_{gap} + R_{pm} = \frac{\delta}{\mu_0 A} + \frac{\text{omkrets} - \delta}{\mu_0 \mu_{r_{pm}} \cdot A} \approx 2{,}852 \cdot 10^6 \ 1/H$$

$$\Rightarrow B_{gap} \approx \underline{\underline{0{,}19\ T}} \quad \text{riktn} \rightarrow$$

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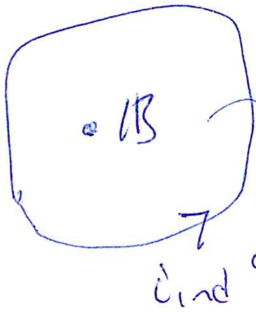
(3)



$B>0 \Rightarrow \odot$ $\quad R_{slinga} = 20\ \Omega$

area $= A = 0{,}04\ m^2$, $B = B_0 \cdot \sin^2 \omega t =$

$= 0{,}02 \cdot \sin^2(10^3 t)$ tesla

$$i_{ind} = \frac{u_{ind}}{R_{slinga}} = -\frac{A}{R_{slinga}} \frac{dB}{dt} = -\frac{A B_0 \omega}{R_{slinga}} 2 \sin\omega t \cos\omega t =$$

$$= -\frac{A B_0 \omega}{R_{slinga}} \cdot \sin(2\omega t)$$

$$\Rightarrow \quad \underline{\underline{|i_{ind}|_{min} = 0}}, \quad |i_{ind}|_{max} = \frac{A B_0 \omega}{R_{slinga}} = \underline{0{,}04\ T}$$

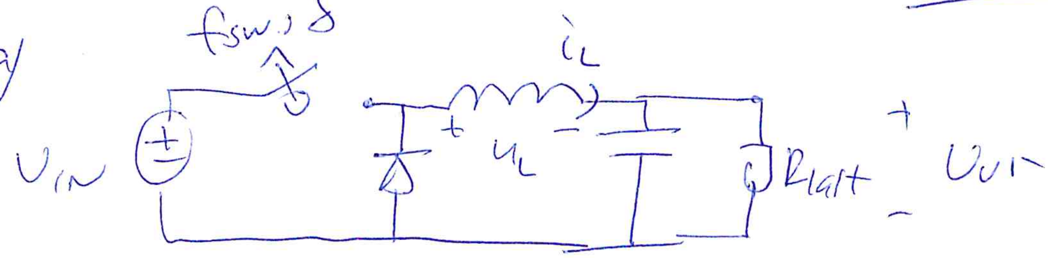
Strömriktn. vid tiden för 1:a strömmax. efter $t>0$:

$|i_{ind}|_{max}$ inträffar då $2\omega t = \frac{\pi}{2} \Rightarrow t = \frac{\pi}{4\omega}$

$\Rightarrow i_{ind} = -\frac{A B_0 \omega}{R_{slinga}} < 0$ vid denna tid $\Rightarrow$ i_{ind} medurs

④ $U_{IN} = 20V$, $U_{UT} = 12V$ ⇒ <u>step down omv.</u>

a/



$u_L = U_{IN} - U_{UT}$ när brytare i TILL-läge.

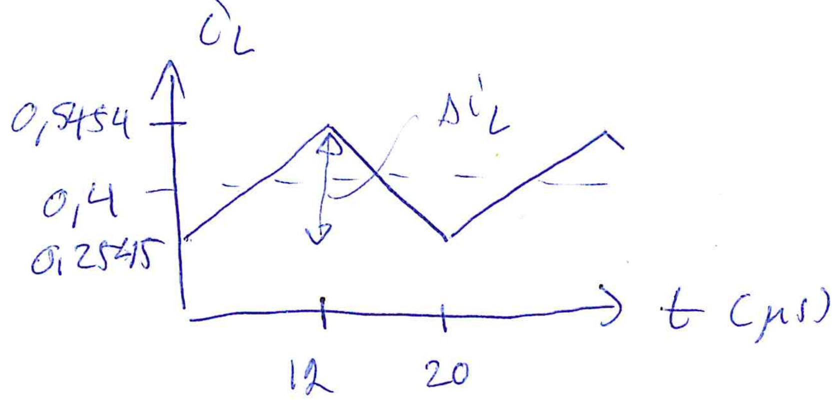
b/ $i_{L,medel} = \frac{U_{UT}}{R_{last}} = 0{,}4$ A

$$\Delta i_L = \frac{u_L \, \Delta t}{L} = \frac{(U_{IN} - U_{UT}) \cdot \delta \cdot T}{L} \approx 0{,}2909 \text{ A}$$

tex, TILL-läge

$\delta = \frac{U_{UT}}{U_{IN}} = 0{,}6$

$T = \frac{1}{f_{sw}} = 2 \cdot 10^{-5}$ s



Brytaren sluten 0 → 12 µs

—"— öppen 12 → 20 µs

c/ Tex. ESR hos kondensator, viss upp/urladdn. av kond.

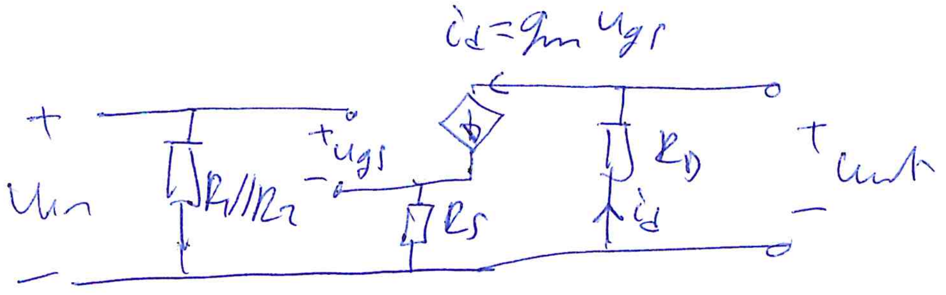
5 a) $$\sqrt{I_D} = \underbrace{\sqrt{\frac{k}{2}}}_{0{,}316} \cdot U_{GS} - \underbrace{\sqrt{\frac{k}{2}} \cdot U_T}_{0{,}474}$$

$$\Rightarrow \underline{\underline{k \approx 0{,}20}}\ \mathrm{A/V^2}, \quad U_T = \underline{\underline{1{,}5\ \mathrm{V}}}$$

b) $$\left.\begin{aligned} &\frac{R_2}{R_1+R_2} V_{DD} - U_{GSQ} - R_S I_{DQ} = 0 \\ &I_{DQ} = \frac{k}{2}(U_{GSQ}-U_T)^2 = 0{,}068\ \mathrm{A} \end{aligned}\right\} \Rightarrow \underline{\underline{R_2 \approx 82\ \mathrm{k\Omega}}}$$

c) $$P_{transistor} = U_{DSQ} \cdot I_{DQ} = (V_{DD} - R_D I_{DQ} - R_S I_{DQ}) \cdot I_{DQ}$$

$$\approx \underline{\underline{66\ \mathrm{mW}}}$$

d) 

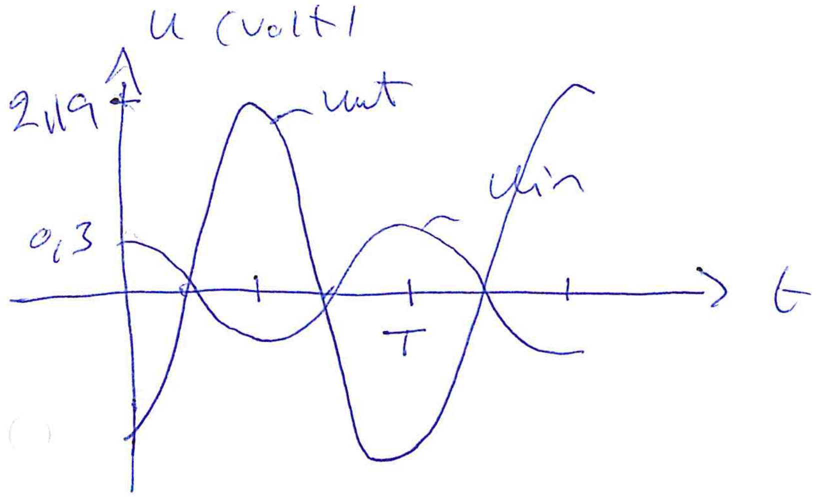
$$R_{ut} = R_D = \underline{\underline{330\ \Omega}}$$

e) $$\left.\begin{aligned} u_{ut} &= -g_m \cdot u_{gs} \cdot R_D \\ u_{in} &= u_{gs} + g_m u_{gs} \cdot R_S \end{aligned}\right\} \Rightarrow A_u = \frac{u_{ut}}{u_{in}} = -\frac{g_m R_D}{1+g_m R_S}$$

$$g_m = k(U_{GSQ} - U_T) \approx 8{,}2\ \mathrm{A/V}$$

⇒ $A_u \approx -7{,}3$ gånger ⇒ $u_{ut} = A_u \cdot u_{in} = -2{,}19 \cdot \cos(2\pi 12 \cdot 10^3 t)$ volt

$0{,}3 \cdot \cos(2\pi 12 \cdot 10^3 t)$



$T = \frac{1}{12 \cdot 10^3} \approx 83\,\mu s$

f) Om R_L ansluts ⇒ $u_{ut} = (R_L // R_D)\, g_m u_{gs}$

⇒ $A_u = -\frac{g_m \cdot (R_L // R_D)}{1 + g_m R_S}$ ⇒ $|A_u|$ minskar ty $R_L // R_D < R_D$

∴ $\hat{u}_{ut}$ minskar.

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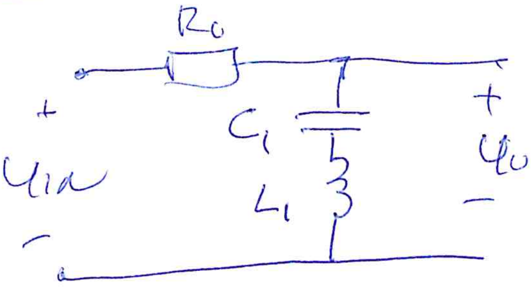
6 a) $R_2 \to \infty$ ⇒



$\omega_r = \frac{1}{\sqrt{L_1 C_1}}$ ⇒ $f_r = \frac{\omega_r}{2\pi} \approx 19{,}3$ kHz

I_{max} då $\omega = \omega_R$ ($Z_{tot} = R_0$ då) ⇒ $I_{max} = \frac{U_{IN}}{R_0} = 0{,}02$ A

Bandspärrfilter: $u_{ut} \approx 0$ då $\omega = \omega_r$

$u_{ut} \approx u_{in}$ då $\omega \ll \omega_r$ & $\omega \gg \omega_r$

kond. 'avbrott' induktor 'avbrott'

b/ Resonans inträffar ej om ω_r imaginär.

$$Z_{tot} = R_0 + j\omega L_1 + \frac{R_2 \frac{1}{j\omega C_1}}{R_2 + \frac{1}{j\omega C_1}} = \ldots =$$

$$= R_0 + j\omega L_1 + \frac{R_2}{1 + (\omega R_2 C_1)^2} - \frac{j\omega R_2 C_1}{1 + (\omega R_2 C_1)^2}$$

$$\operatorname{Im} Z_{tot} = 0 \quad \Rightarrow \quad \omega = \frac{1}{C_1 R_2} \sqrt{\frac{C_1}{L_1} R_2^2 - 1}$$

$\Rightarrow$ ω imaginär om $R_2 < \sqrt{\frac{L_1}{C_1}} \approx 82{,}5\,\Omega$

∴ Resonans saknas om $\underline{\underline{R_2 < 82\,\Omega}}$

Högpassfilter: $|U_{ut}| \approx |U_{in}|$ höga ω (induktor "avbrott")

$|U_{ut}| \approx \frac{R_2}{R_1 + R_2} |U_{in}|$ låga ω

(kond. i "avbrott", ström genom R_2, ind. "kortslutn.")