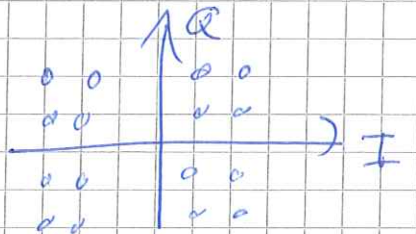
RRY 010 Telekommunikation — Korta svar/lösn.

Tentamen 14/1 2020

(1) a/ Se kursbok.



(ex. på 16-QAM)

b/ Se kursbok + lab 3-4. DSB-FC & ASK kan demoduleras.

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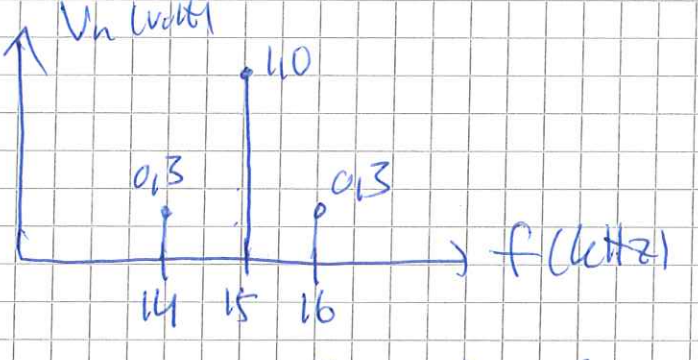
(2)

$$\left.\begin{aligned} V_c + V_m &= V_{max} \\ V_c - V_m &= V_{min} \end{aligned}\right\} \Rightarrow V_c = 1{,}0\,V \;\&\; V_m = 0{,}6\,V$$

$$T_m = 1\,ms \;\&\; T_c = \frac{T_m}{15} \Rightarrow \begin{aligned} f_m &= 1\,kHz \\ f_c &= 15\,kHz \end{aligned}$$

a)



b) $P_{medel} = \frac{1}{2R} \cdot \left\{ \left(\frac{V_m}{2}\right)^2 + V_c^2 + \left(\frac{V_m}{2}\right)^2 \right\} = 0{,}0118\,W \approx \underline{\underline{12\,mW}}$

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(3) a)

$$\left.\begin{aligned} f_c + \Delta f_c &= f_{max} \\ f_c - \Delta f_c &= f_{min} \end{aligned}\right\} \Rightarrow \Delta f_c = 10\,kHz \Rightarrow \beta = \frac{\Delta f_c}{f_m} = 1{,}0$$

$$\therefore B \approx 2 f_m (1+\beta) = \underline{\underline{40\,kHz}}$$

b) P inom B: $\frac{V_c^2}{2R} \left\{ |J_0(1)|^2 + 2 \cdot |J_1(1)|^2 + 2 \cdot |J_2(1)|^2 \right\}$

P totalt: $\frac{V_c^2}{2R}$ $\quad \therefore$ Andel inom B $\approx \underline{\underline{0{,}9993}}$.

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$$v_{in} = v_1 \cdot \cos(\omega_c t) + v_2 \sin(\omega_c t)$$

Efter övre blandaren:

$$v_A = v_{in} \cdot \cos(\omega_c t + \Delta\omega_c t) =$$

$$= v_1 \cdot \frac{1}{2} \left\{ \cos(-\Delta\omega_c t) + \cos(2\omega_c t + \Delta\omega_c t) \right\} +$$

$$+ v_2 \frac{1}{2} \left\{ \sin(-\Delta\omega_c t) + \sin(2\omega_c t + \Delta\omega_c t) \right\}$$

LP-Filtren $\Rightarrow$ $v_{ut,A} = \frac{1}{2} \left\{ v_1 \cdot \cos(\Delta\omega_c t) - v_2 \sin(\Delta\omega_c t) \right\}$

Efter nedre blandaren:

$$v_B = v_{in} \cdot \sin(\omega_c t + \Delta\omega_c t) =$$

$$= v_1 \frac{1}{2} \left\{ \sin(\Delta\omega_c t) + \sin(2\omega_c t + \Delta\omega_c t) \right\} +$$

$$+ v_2 \frac{1}{2} \left\{ \cos(\Delta\omega_c t) - \cos(2\omega_c t + \Delta\omega_c t) \right\}$$

LP-filtren $\Rightarrow$ $v_{ut,B} = \frac{1}{2} \left\{ v_1 \cdot \sin(\Delta\omega_c t) + v_2 \cdot \cos(\Delta\omega_c t) \right\}$

$$\therefore\ v_{ut,A} = \frac{1}{2}\left\{ v_1 \cdot \cos(\Delta\omega_c t) - v_2 \cdot \sin(\Delta\omega_c t) \right\}$$

$$v_{ut,B} = \frac{1}{2}\left\{ v_1 \cdot \sin(\Delta\omega_c t) + v_2 \cos(\Delta\omega_c t) \right\}$$

I båda fallen är meddelandena nu modulerade med signal på $\Delta\omega_c$, samt både v_1 & v_2 bidrar till båda utgångarna, dvs. "stör".

$$\left(\Delta\omega_c = 0 \text{ skulle ge: } \begin{array}{l} v_{ut,A} = \frac{1}{2} v_1 \\ v_{ut,B} = \frac{1}{2} v_2 \end{array} \right)$$

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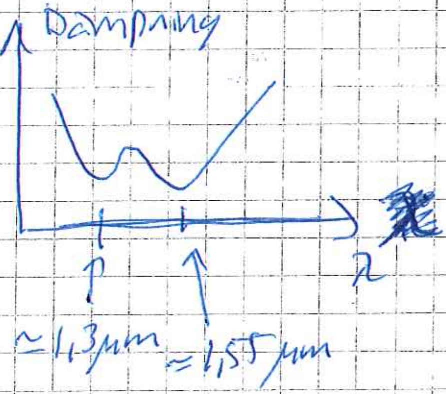
(5) a)



Grafen visar dämpningen som fkn av λ.

b) $NA = n_0 \sin\theta_a \Rightarrow \theta_a = \arcsin NA \simeq 0{,}1405$ rad

sätt $n_0 = 1$

$\simeq \underline{8{,}0^\circ}$

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(6) Använd Smithdiagr.

a) $Z_{in} \simeq 180 - j130\ \Omega$

b) Enda minimat inträffar $0{,}328\lambda$ från lasten.

$|V|_{min} = |V^+_{(0)}|\,(1+|\Gamma|) = 4\cdot(1-0{,}7) = \underline{1{,}2 \text{ volt}}$

c) $\lambda/4$-transf: $Z_{0,tr.} \simeq 115\ \Omega$, ansluts $0{,}078\lambda$ från last
parallellkoppl., kortsluten stubbe: längd $0{,}08\lambda$, ansluts $0{,}262\lambda$ från last.

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$z_L = \frac{4}{5} + j\frac{8}{5} = 0{,}8 + j1{,}6$

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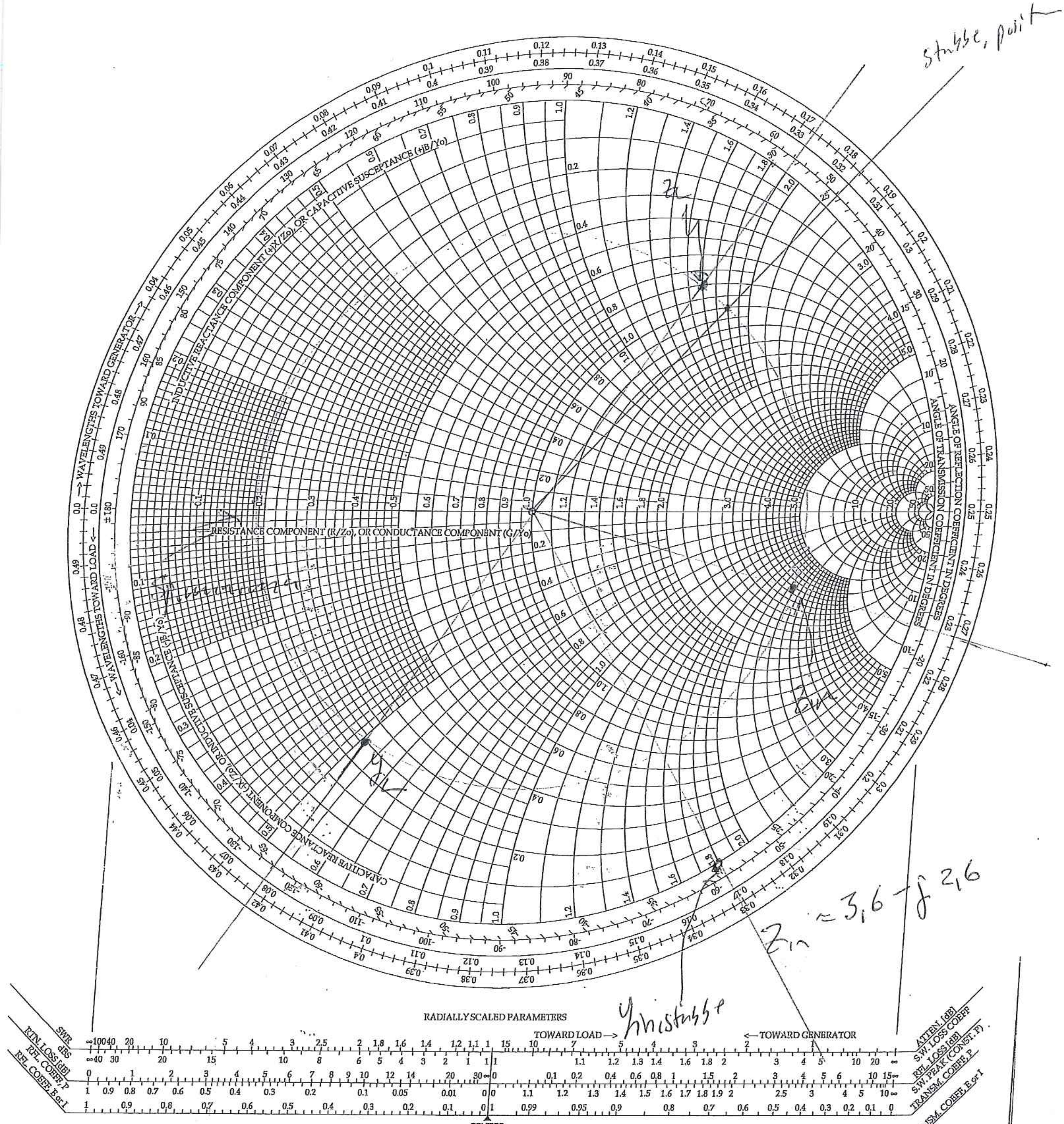
Smith Chart



$|\Gamma| \approx 0{,}7$

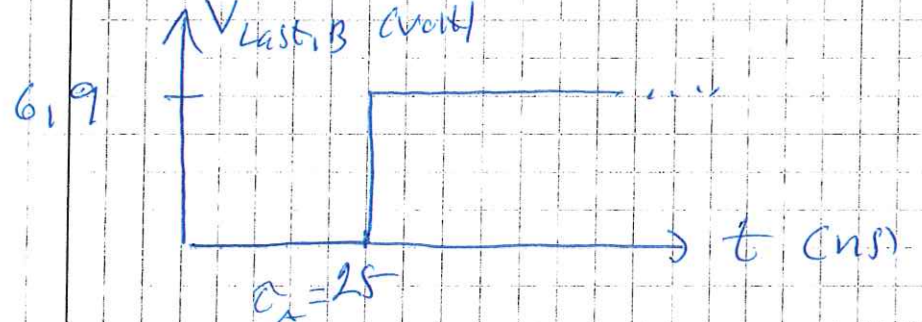
7)

a) $Z_{L,A} \to \infty \Rightarrow$ påverkar ej

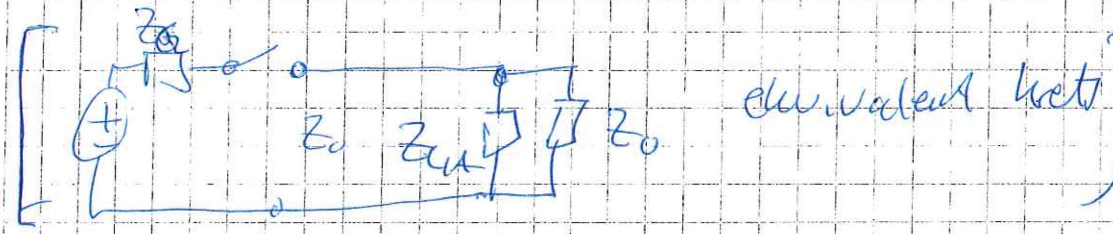
$Z_{L,B} = Z_0 \Rightarrow \Gamma_{L,B} = 0 \Rightarrow$ inga reflexer

$$V_0^+ = \frac{Z_0 V_G}{Z_0 + Z_G} \simeq 6,857 \simeq \underline{\underline{6,9 \text{ volt}}}$$

$$\tau_A = \frac{l_A + l_B}{v_{våg}} = 25 \text{ ns}$$



b) $$\Gamma_{L,A} = \frac{Z_{L,A} // Z_0 - Z_0}{Z_{L,A} // Z_0 + Z_0} = \frac{50-100}{50+100} = -\frac{1}{3}$$



$\tau_B = 15$ ns

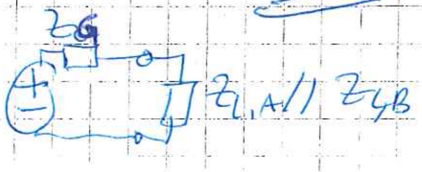
$$\Gamma_G = \frac{Z_G - Z_0}{Z_G + Z_0} = \frac{75-100}{75+100} = -\frac{1}{7}$$

$\underline{t = 0:}$ $V_{ingång} = V_0^+ \simeq \underline{\underline{6,9 \text{ volt}}}$

$\underline{t = 40 \text{ ns}:}$ En last- & en gen. reflex har skett

$$V_{ingång} = V_0^+ + V_0^- + V_1^+ = V_0^+ \cdot (1 + \Gamma_{L,A} + \Gamma_{L,A}\Gamma_G)$$
$$\simeq \underline{\underline{4,9 \text{ volt}}}$$

$\underline{t \to \infty:}$



$\Rightarrow V_{ing} = \underline{\underline{4,8 \text{ volt}}}$

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$$Z_0 = \frac{87}{\sqrt{\varepsilon_r + 1{,}41}} \ln\left(\frac{5{,}98h}{0{,}8W}\right)$$

$$\Rightarrow W \approx \cancel{\ldots} \; \underline{4{,}71\,mm}$$

$$v_{fas} = \frac{c_0}{\sqrt{\varepsilon_{eff}}}$$

$$\varepsilon_{eff} = 0{,}475\,\varepsilon_r + 0{,}67$$

$$\Rightarrow \lambda = \frac{v_{fas}}{f} \approx 0{,}021668\,m$$

$$l = \frac{\lambda}{4} = 0{,}00542\,m = \underline{\underline{5{,}42\,mm}}$$