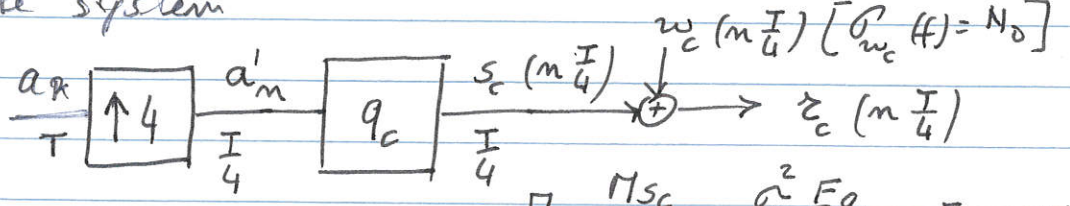
DIGITAL TRANSMISSION — MAY 3, 2016

HW3 — DUE MAY 19, 2016

Consider the system



$$\Gamma = \frac{M s_c}{N_0 \frac{1}{T}} = \frac{\sigma_a^2 E_{q_c}}{\sigma_{w_c}^2} \; ; \; E_{q_c} = \sum_m \left| q_c\left(m\tfrac{T}{4}\right)\right|^2$$

where

a_k : QPSK

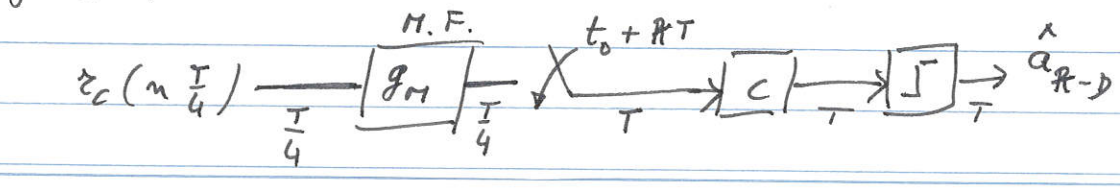
$$a'_m = \begin{cases} a_k, & n = 4k \\ 0, & \text{otherwise} \end{cases} \quad \text{(upsampler)}$$

$$s_c\left(n\tfrac{T}{4}\right) = \alpha\, s_c\left((n-1)\tfrac{T}{4}\right) + \beta\, a'_{n-10} \quad , \alpha = 0.67, \; \beta = 0.7424$$

Based on this scheme, known at the receiver, design the various receivers

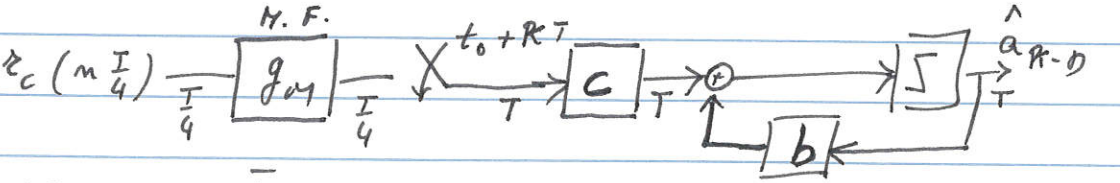
- Plot q_c and $|G_c(f)|$, in dB, for $f \in (0, \frac{2}{T})$
- Let $t_0 = \bar{t}_0 \cdot \frac{T}{4}$, $\bar{t}_0$ an integer.
- All designed filters must be causal.

a) (10 p)



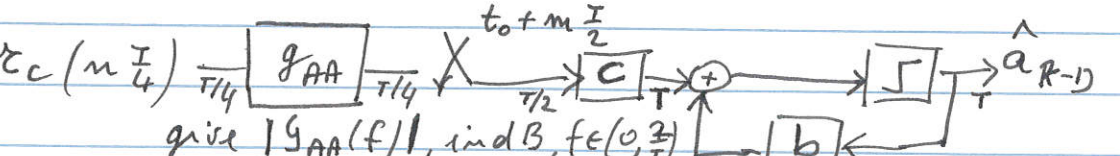
For $\Gamma = 11$ dB : give $\bar{t}_0$, M_1, D, g_M, c, γ,

b) (10 p)



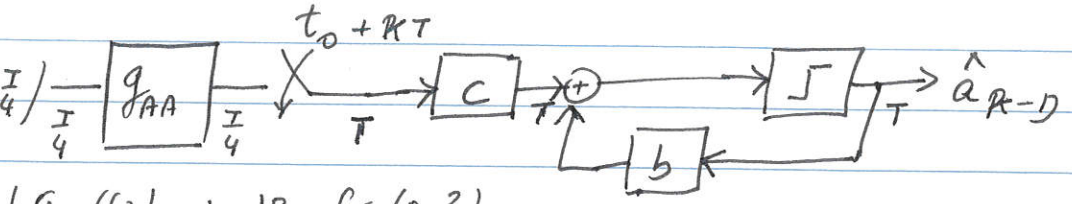
For $\Gamma = 11$ dB : give $\bar{t}_0$, M_1, M_2, D, g_M, c, γ, b

c) (10 p)



give $|G_{AA}(f)|$, in dB, $f \in (0, \frac{2}{T})$

For $\Gamma = 11$ dB : give t_0, M_1, M_2, D, g_{AA}, c, γ, b

(d) (10p) 

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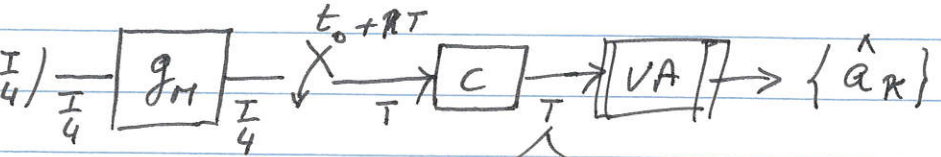
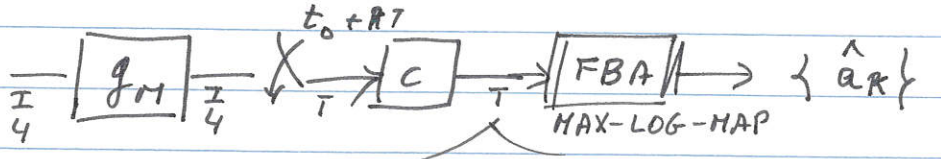
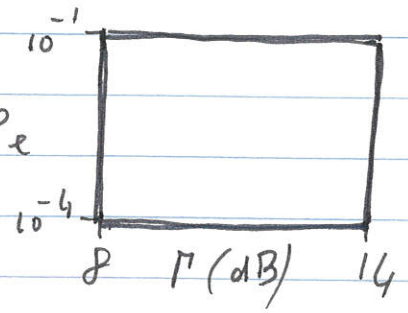
(e) (10p) 

The VA is using the 'channel' as given by $\gamma_D, \gamma_{D+1}, \ldots, \gamma_{D+M_2}$ in 'Receiver (b)'. Give the state definition.

(f) (10p) 

The FBA is using the 'channel' as given by $\gamma_D, \gamma_{D+1}, \ldots, \gamma_{D+M_2}$ in 'Receiver (b)'. Give the state definition.

For each scheme determine the probability of error P_e, by simulation, for various values of Γ; let $8 \le (\Gamma)_{dB} \le 14$, and $10^{-1} \ge P_e \ge 10^{-4}$. For each Γ, design the various filters (but do not report values). Plot also P_e vs Γ given by the 'M.F. bound', both as given by theory and by simulation. In conclusions there are eight curves



MF + LE@T	'blue dashed'
MF + DFE@T	'blue solid'
AAF + DFE@T/2	'black dashed'
AAF + DFE@T	'black solid'
VA	'red dashed'
FBA (Max-Log-MAP)	'red solid'
MF bound - Sim: $\gamma_k = a_k + w_k$,	$\Gamma = \tilde{a}^2/\hat{a}_w^2$
MF bound - theory	'green solid'.

'green dashed'

↑ Use this legend (last in bold), in this order and with the given corresponding colors.