1)

B = ?

PT = ?

$f_m = 12 kHz$

$B = 200 kHz$

$At = 20 dB$

$SNR = 35 dB$

$N_0 = 10^{-5} \frac{W}{Hz}$

a) $SNR_{(dB)} = 10 \log(SNR_0)$

$35 = 10 \log_{10} SNR_0$

$\log SNR_0 = 3,5$

$SNR_0 = 10^{3,5} = 3166,28$

$SNR_0 = 35 dB$

B =

$f_m = \frac{SNR_0}{SNR_c}$ $\quad f_m = \frac{3}{2}\beta^2 = 20(\beta+1)$

$\frac{SNR_0}{SNR_c} = \frac{3}{2}\beta^2 \rightarrow SNR_0 = \frac{3}{2}\beta^2 \cdot SNR_c$

$SNR_0 = \frac{3}{2}\beta^2 \cdot 20(\beta+1)$

$SNR_0 = 30\beta^3 + 30\beta + 30 = 10^{3,5}$

$30\beta^3 + 30,3 + (30 - 10^{3,5}) \longrightarrow 4,6380$

Largura de espectro = faixa do canal

$B_T = B$

$B_T = 2(\beta+1)\, f_m = 200 kHz$ $\quad \beta + 1 = 8,33$

$2(\beta+1) \cdot 12 kHz = 200 kHz$ $\quad \beta = 7,33$

$(\beta+1) = \frac{200 kHz}{24 kHz}$

$B = 4,6380$ Utilizando o β mais restrito

b) $SNR_c = ?$

$SNR_o = f_{mo} \, SNR_c$

$SNR_o = \frac{3}{2} \cdot \beta^2 \cdot SNR_c$

$10^{3,5} = \frac{3}{2} \cdot 4,6380 \, SNR_c$

$SNR_c = 454,54 W$

em dB

$SNR_c \, dB = 10 \log 454,54$

$26,57 dB$

$SNR_c = \frac{P_R}{W N_0}$

$454,54 = \frac{P_R}{12,4 \cdot 10^{-5}}$

$P_R = 54,54 W$

$17,36 dB$

d) $PT = ?$

$P_{2dB} = PT - AT$

$17,36 = PT - 20$

$PT = 37,36 dB$

$PT = P_n + At$

13)

$$g(t) = 10\cos(30\pi t)\cos(200\pi t)$$

$$g(t) = 10\cos(2\pi \cdot 15t)\cos(2\pi \cdot 100t)$$

$$g(t) = \frac{10 \cdot \cos(2\pi t(15+100)) + \cos(2\pi t(15-100))}{2}$$

$$g(t) = 5\cos(2\pi \cdot 115t) + \frac{1}{2}\cos(2\pi \cdot 85t)$$

$$g(f) = 2{,}5\,\delta(f \pm 115) + \frac{1}{4}\delta(f \pm 85)$$

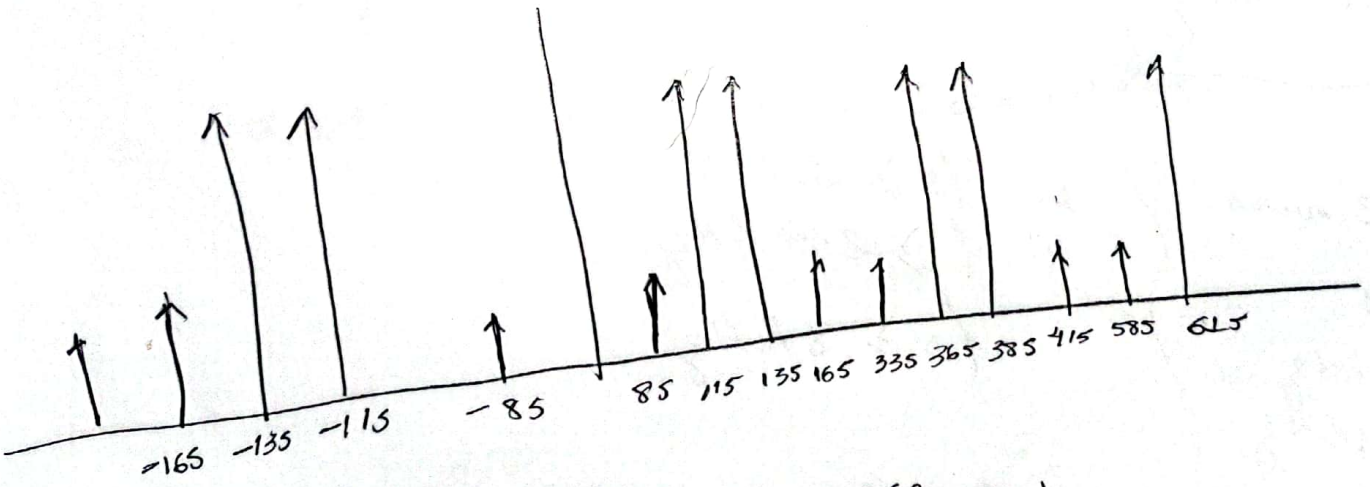
$$G_s(f - nf_s) = G(f - 250n) = 2{,}5\,\delta(f - 250n \pm 115) + \frac{1}{4}\delta(f - 250n \pm 85)$$

$$G_s(f - nf_s) = 2{,}5\,\delta(f - 250n \pm 115) + \frac{1}{4}\delta(f - 250n \pm 85)$$

$$G_s(f) = \frac{1}{T_s}\sum G\left(f - \frac{n}{T_s}\right)$$

$$G_1(f) = 250 \sum G(f - 250n)$$

$$G_1(f) = 625 \sum \delta(f - 250n \pm 115) + 62{,}5 \sum \delta(f - 250n \pm 85)$$



$n = 0 \rightarrow 625\,\delta(f \pm 115) + 62{,}5\,\delta(f \pm 85)$

$n = 1 \rightarrow 625\,\delta(f - 250 \pm 115) + 62{,}5\,\delta(f - 20 + 85)$

c) critério de Nyquist

$f_s \geq 2w$, $f_s \geq 2 \cdot 100$

$f_s \geq 200\,Hz$

$f_s = 250$ atende ao critério

b) Um filtro passa baixa ideal recupera

$165 < f_{3dB} < 335\,Hz$

20) $2^{10} = 1024$ $N = 10$

$w = 4,5\,MHz$

$Q = 1024$ níveis

$f_s \geq 2w$

$f_s \geq 24,5\,MHz$ * (1,2) corr.

$f_s = 10,8\,MHz$

$R_b = \frac{1}{\tau} = \frac{N}{T_s} = N f_s$

$R_b = 10 \cdot 10,8\,MHz$

$R_b = 108\,Mbits/s$

22) 32 níveis

$N = 4$

$f_s = 5\,kHz$

$w = 4\,kHz$

$Q = 32$

a) $f_s \geq 2w$

$f \geq 2 \cdot 4\,kHz$

$f_s \geq 8\,kHz$

b) $Kb = \frac{N}{Ts} = N f_s = 4 \cdot 5KHz = \underline{20k}$

↳ Amostras

c) $Q = 2^v$ Tempo de cada bit

$32 = 2^v$ $\Delta t = \frac{1}{Tb} = \frac{1}{\frac{T}{v}} = \frac{10}{T}$

$v = 10$

$R_b = \frac{10}{T} = 10 \cdot f_s = 50Kbits$

↳ 4 canais → 200kbits

d) $B_{cod} = \frac{1}{Tb} = \frac{1}{\frac{T}{v}} = \frac{10}{T} = 10 \cdot f_s$

$B_{cod} = Nv \cdot f_s = 4 \cdot 10 \cdot 5K = 200KHz$

23)

$B = 3,5KHz$ $B_T = \frac{R_s}{2}(1+\alpha)$

$\alpha = 0,25$ $R_b = \frac{2B_T}{(1+\alpha)} = 5,6Kbits/s$