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Questão 1.

a) $\text{sinc}(200t)$, $\omega = 2\pi f$

$$f = \frac{200}{2\pi} = 31,83 \text{ Hz} \qquad f_n = 2f = 63,66 \text{ Hz}$$

$$T_N = \frac{1}{f_n} = 0,015 \text{ s}$$

b) $\text{sinc}^2(200t)$, $\omega = 2\pi f$

$$f = \frac{200}{2\pi} = 31,83 \text{ Hz} \qquad f_n = 63,66 \text{ Hz}$$

$$T_n = \frac{1}{f_n} = 0,015 \text{ s}$$

c) $\text{sinc}(200t) + \text{sinc}^2(200t)$
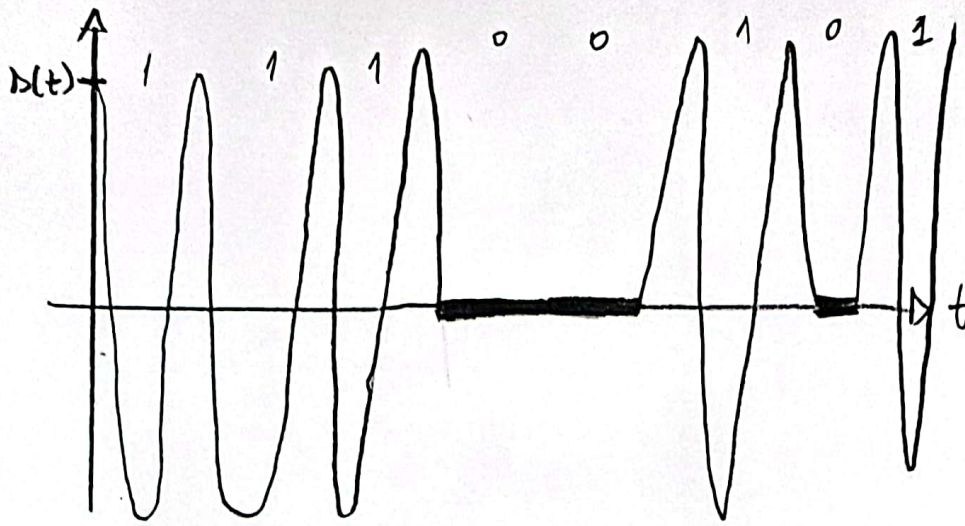
$$f_{nt} = 63,66 \text{ Hz}$$
$$T_{Nt} = 0,015 \text{ s}$$

Questão 2.

a)
$$T_o = 1\mu\text{s} \qquad R_b = 1Mbs \qquad B = 2R_b = 2Mbps$$
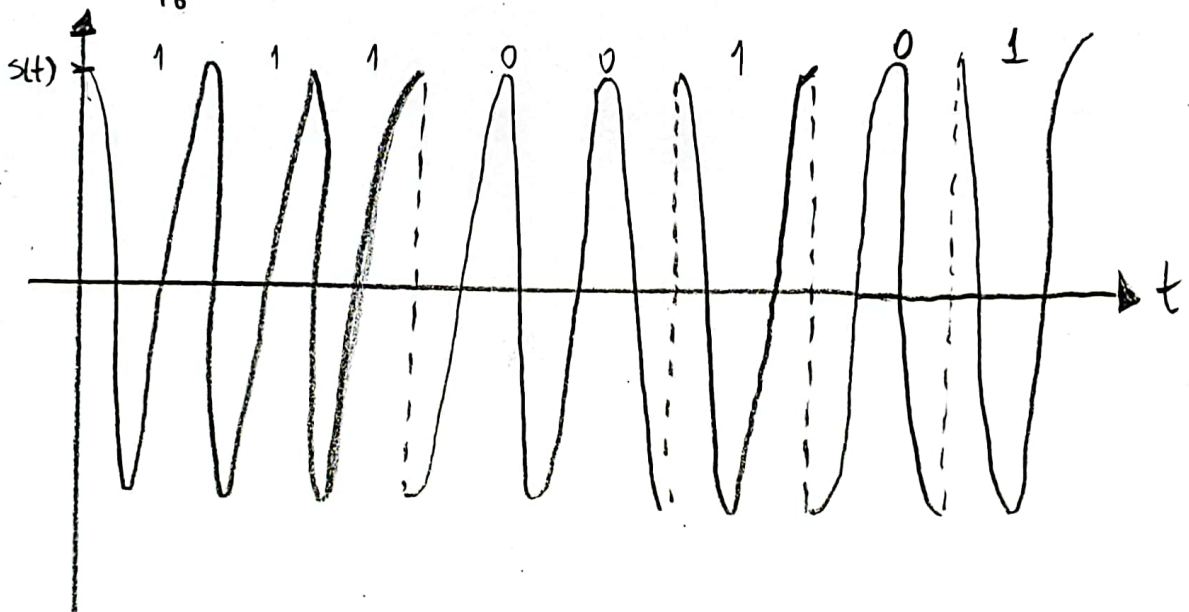$$f = 7MHz$$

b)
$$S(t) = \begin{cases} \sqrt{\dfrac{2E_b}{T_b}} \cos(2\pi f_c t), & \text{Símbolo 1} \\ \\ 0, & \text{Símbolo 0} \end{cases}$$

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Questão 3.

$T_b = 1\mu s$ $R_b = \dfrac{1}{T_b} = 1\,Mbps$ $B = 2\,R_b \Rightarrow 2\,Mbps$

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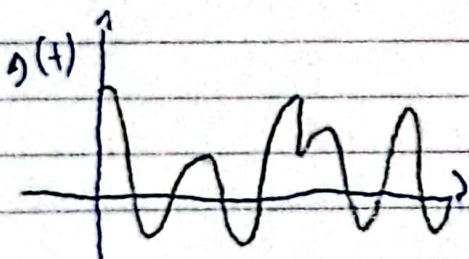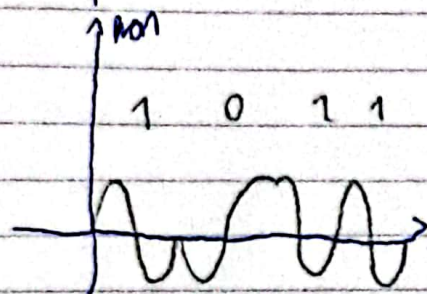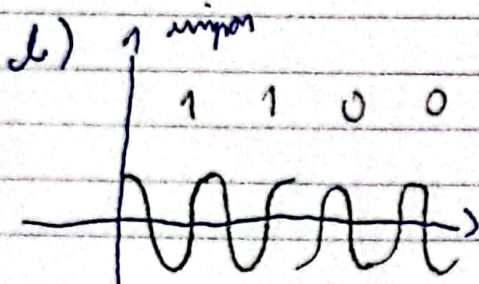## Q4-

$1 1 0 0 1 0 1$

a) $t_b = \frac{1}{R_b}$, $R_b = \frac{1}{2 \cdot 10^{-6}}$ → 1 Mbps

$N = \log_2 4 = ②$

$B = \frac{R_b}{2} = 0,5$ Mbps

b)

1 1 0 0

1 0 1 1

$g(t)$

Q5-

1 1 1 0 0 1 0 1

Q6- MSK

$fc = 50$ MHz

$R_b = 20 \cdot 10^3$ → $T_b = \frac{1}{R_b} = 50 \mu s$
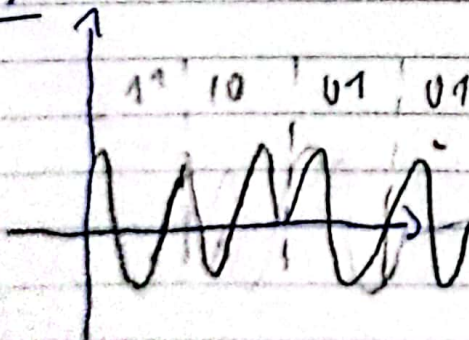
$f_i = fc \pm \frac{1}{2 T_b} = 50m \pm 10^4$

$f_{i0} = 49,99$ MHz bit$_0$
$f_{i1} = 50,01$ MHz bit$_1$
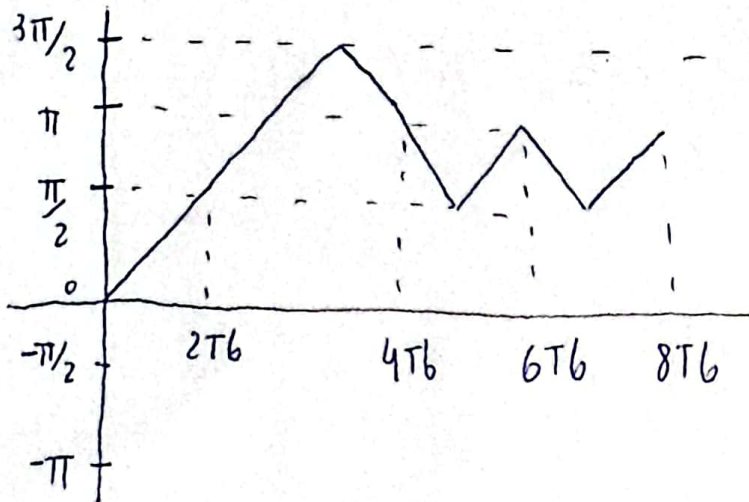
d) $f_i \approx fc = 50$ MHz
$f_{i1} \approx 50,01$ MHz

Questão 7

$T_b = 1\mu s \rightarrow$ duração do bit

$f_0 = 2,5 MHz$

$f_f = 3MHz$

Questão 8

Foi anulada ⊗

Questão 9

$N_0 = 10^{-10}$

$P_e = 10^{-4}$

$R_b = 1 mbps$

$P_m = E_b \cdot R_b$

$P_m = 6,9155 \times 10^{-4}$

$E_b \simeq 6,9155 \times 10^{-10}$ //

$10^{-4} = \dfrac{1}{2} \, erfc\left(\sqrt{\dfrac{E_b}{10^{-10}}} \right)$

$E_b = erfc(2\times 10^{-4})^2 \cdot 10^{-10}$

Questão 10

$Rb = 2,5\, Mbps$

$No = 10^{-20}$

$A = 1\mu V$

$Tb = \dfrac{1}{Rb}$

$Eb = \dfrac{A^2\, Tb}{2}$

(a) $Pe = \dfrac{1}{2}\, erfc\left(\sqrt{\dfrac{Eb}{2No}}\right)$

$Pe = 3,8721 \times 10^{-6}$

(b) $Pe \simeq erfc\left(\sqrt{\dfrac{Eb}{No}}\right) \simeq 2,5396 \times 10^{-10}$