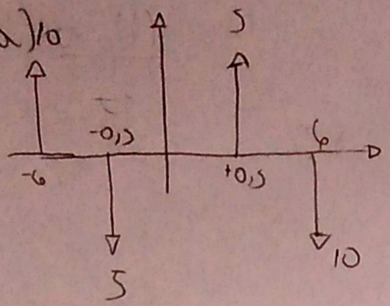
① a)



$$G(f) = \frac{F\left[\frac{d\,g(t)}{dt}\right]}{[j2\pi f]} =$$

$$10\delta(t+6) - 10\delta(t-6) - 5\delta(t+0{,}5) + 5\delta(t-0{,}5)$$

$$= \frac{1}{[j2\pi f]}\left[\cdot\, 10\left[e^{j2\pi f 6} - e^{-j2\pi f 6}\right] + 5\left[e^{-j2\pi f 0{,}5} - e^{+j2\pi f 0{,}5}\right]\right]$$

$$\frac{d^n g(t)}{dt^n} = 2\pi G(f) = \frac{2\pi f}{4\pi^2 f^2}\left[10\left[e^{j2\pi f 6} - e^{-j2\pi f 6}\right] + 5\left[e^{-j2\pi f 0{,}5} - e^{+j2\pi f 0{,}3}\right]\right]$$

b) $n = 1$; derivadas
$m = 4$; impulsos

c) $b = \{0{,}5\ ;\ -0{,}5\ ,\ 6\ ,\ -6\}$
$a = \{+5,\ +5,\ 10,\ 10\}$

d)

(2) DSB

$m(t) = 4\cos(2\pi 2k t) + 4\cos(2\pi 4k t)$

$c(t) = 10\cos(2\pi 50k t)$

a) $m(t) = 4\cos(2\pi 2 \cdot 10^3 t) + 4\cos(2\pi \cdot 4 \cdot 10^3 t)$

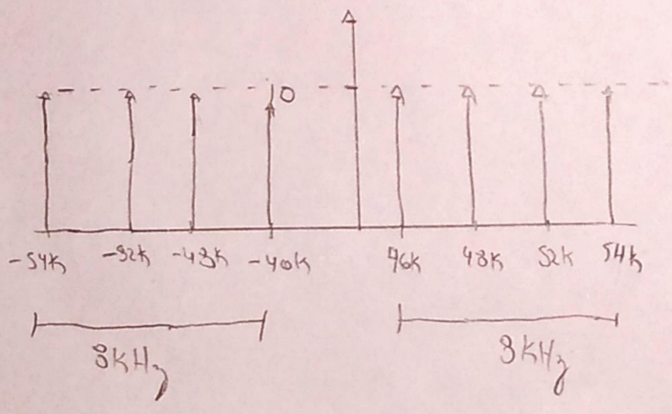
$s(t) = m(t)\, c(t)$

$s(t) = \left[4\cos(2\pi 2 \cdot 10^3 t) + 4\cos(2\pi \cdot 4 \cdot 10^3 t)\right] \cdot \left[10\cos(2\pi \cdot 50 \cdot 10^3 t)\right]$

$$s(t) = \frac{4 \cdot 10}{2}\left[\cos(2\pi\, 52 \cdot 10^3 t)\right] + \frac{4 \cdot 10}{2}\left[\cos(2\pi\, 48 \cdot 10^3 t)\right] + \frac{4 \cdot 10}{2}\left[\cos(2\pi\, 54 \cdot 10^3 t)\right] + \frac{4 \cdot 10}{2}\left[\cos(2\pi\, 46 \cdot 10^3 t)\right]$$

$$s(t) = 20\left[\cos(2\pi\, 52 \cdot 10^3 t)\right] + 20\left[\cos(2\pi \cdot 48 \cdot 10^3 t)\right] + 20\left[\cos(2\pi\, 54 \cdot 10^3 t)\right] + 20\left[\cos(2\pi\, 46 \cdot 10^3 t)\right]$$

$$s(t) = 10\left\{\left[\delta(f - 52k) + \delta(f + 52k)\right] + \left[\delta(f - 48k) + \delta(f + 48k)\right]\right\} + 10\left\{\left[\delta(f - 54k) + \delta(f + 54k)\right] + \left[\delta(f - 46k) + \delta(f + 46k)\right]\right\}$$



b) $f_c = 50\,kHz$ Apenas passarão as frequências entre

$BW = 5\,kHz$ 47,5 kHz ~ 52,5 kHz, assim temos

$$s(t) = 20 \cdot [\cos(2\pi\, 52\,10^3 t) + \cos(2\pi\, 49 \cdot 10^3 t)]$$

$$P = \frac{20^2}{2} + \frac{20^2}{2} = 400\,W$$

c) $c'(t) = 1\cos(2\pi\, 50k\, t)$

$$s(t) \rightarrow \boxed{\times} \xrightarrow{v(t)} \boxed{FPB} \rightarrow v_0(t)$$

$$c'(t) \uparrow$$

$$A_t(dB) = 20 \log(At)$$

$$-28 = 20 \log(At)$$

$$At = 10^{-1,4}$$

$$\frac{1}{\sqrt{1 + \left(\frac{f_x}{f_{3DB}}\right)^2}} = 10^{-1,4} \Rightarrow 1 + \left(\frac{f_x}{f_{3DB}}\right)^2 = 10^{2,8}$$

$$f_x \approx 10^{2,8} f_3 dB$$

$$f_{3DB} \approx \frac{f_x}{10^{2,3}}$$

$$v(t) = s(t)\, c'(t)$$

$$v(t) = \{20\,[\cos(2\pi\, 52\,10^3 t) + \cos(2\pi\, 48\,10^3 t)] + 20\,[\cos(2\pi\, 54 \cdot 10^3 t) + \cos(2\pi\, 46 \cdot 10^3 t)]\}$$

$$\times 1 \cos(2\pi\, 50 \cdot 10^3 t)$$

$\Rightarrow$

$v(t) = 10\left[\cos(2\pi\, 102.10^3 t) + \cos(2\pi\, 2\, 10^3 t) + \cos(2\pi\, 98.10^3 t) + \cos(2\pi\, 2.10^3 t)\right] +$

$10\left[\cos(2\pi\, 104.10^3 t) + \cos(2\pi . 4.10^3 t) + \cos(2\pi\, 96.10^3 t) + \cos(2\pi\, 4.10^3 t)\right]$

$\text{Freq:} \begin{cases} 2\,kHz \\ 4\,kHz \\ 96\,kHz \\ 98\,kHz \\ 102\,kHz \\ 104\,kHz \end{cases}$

Filtrando pelo FPB

$f_{3dB} \approx 96\,kHz . 10^{-1,4} = \underline{3,821\,kHz}$

3) $\begin{cases} \alpha = 0,56 \\ L_1 = L_2 = 5\mu H \\ m(t) = \cos(2\pi . 20.10^3 t) \\ A_m = 10 V_p \\ C_v = \dfrac{200}{(1+0,56.4)^{1/2}} \end{cases}$

a) $V_r = 4$

$C_v = \dfrac{200}{(1+0,56.4)^{1/2}} = 111,111\,pF$

$f_c = \dfrac{1}{2\pi\sqrt{(L_1+L_2)C_v}} = \dfrac{1}{2\pi\sqrt{10.10^{-6} . 111,111.10^{-12}}} = 4,774\,MHz$

$K_c = \dfrac{\Delta c}{\Delta V_r} = \dfrac{122.16p - 102,59p}{3-5} = -9,785\,\dfrac{pF}{V}$

$K_f = \dfrac{-f_c K_c}{2 C_v} = \dfrac{-4,774.10^6 . -9,785.10^{-12}}{2.(111,111.10^{-12})} = 210,21\,k$

$\beta = \dfrac{k_f A_m}{f_m} \Rightarrow 10,510$

$s(t) = 10\cos\left[2\pi\, 4,774.10^6 t + 10,510 . \operatorname{sen}(2\pi\, 20.10^3 t)\right]$

b) $f_i(t) = f_c + k_f \cdot m(t)$

$f_i(t) = 4{,}774 \cdot 10^6 + 210{,}21 \cdot 10^3 \cdot \cos(2\pi \cdot 20 \cdot 10^3 t)$

$f_{i\,max} = 4{,}774 \cdot 10^6 + 210{,}21 \cdot 10^3 = 4{,}984\,MHz$

$f_{i\,min} = 4{,}774 \cdot 10^6 - 210{,}21 \cdot 10^3 = 4{,}563\,MHz$

c) $P = \frac{A_c^2}{2} \Rightarrow \frac{10^2}{2} = 50W$

$B_T = 2(\Delta f + f_m) \Rightarrow 2(210{,}21k + 20k) = 460{,}42\,kHz$