$$g(t) = \begin{cases} 1 - e^{t} & 0 < T_0 < 1.0 \end{cases}$$

MIN DE 95% DE ENERGIA PELO CABO

$y(t) \rightarrow 95\% P_g$

$T_0 = 1\,s \rightarrow f_0 = 1\,Hz \rightarrow \omega_0 = 2\pi$ RAD/S

$$P_g = \frac{1}{T_0}\int_{T_0} g(t)^2 dt = \frac{1}{1}\int_0^1 \left[1-e^{t}\right]^2 dt = \int_0^1 1 - 2e^{t} + e^{2t} = t - 2e^{t} + \frac{e^{2t}}{2}\Big|_0^1$$

$$(1-0) - 2e^{1} - (-2e^{0}) + \frac{e^{2\cdot 1}}{2} - \frac{e^{0}}{2} = 1 - 2e + 2 + \frac{e^2}{2} - \frac{1}{2}$$

$$= \frac{5}{2} - 2e + \frac{e^2}{2} = 0{,}75796\,W$$

$$P_{y(t)} = 95\% P_g = 0{,}7201\,W$$

$$D_n = \frac{1}{T_0}\int_{T_0} g(t) e^{-j\omega_0 n t} dt = \frac{1}{1}\int_0^1 (1-e^{t}) e^{-j\omega_0 n t} dt = \int_0^1 e^{-j\omega_0 n t} - e^{(-j\omega_0 n + 1)t} dt$$

$$= \left(\frac{e^{-j\omega_0 n t}}{-j\omega_0 n} - \frac{e^{(-j\omega_0 n + 1)t}}{-j\omega_0 n + 1}\right)\Big|_0^1 = \frac{e^{-j\omega_0 n}}{j\omega_0 n} + \left(\frac{e^{0}}{+j\omega_0 n}\right) + \left(-\frac{e^{1-j\omega_0 n}}{1-j\omega_0 n}\right) + \left(+\frac{e^{0}}{1-j\omega_0 n}\right)$$

$$= \frac{1 - e^{-j\omega_0 n}}{j\omega_0 n} + \frac{1 - e^{1-j\omega_0 n}}{1-j\omega_0 n}$$

$$D_n = \frac{1 - e^{-j\omega_0 n}}{j\omega_0 n} + \frac{1 - e^{1-j\omega_0 n}}{1 - j\omega_0 n} \Rightarrow \frac{1 - \cos(\omega_0 n) + j\,\mathrm{sen}(\omega_0 n)}{j\omega_0 n}$$

$$\frac{j - j\cos(\omega_0 n) - \mathrm{sen}(\omega_0 n)}{-\omega_0 n} \overset{L'H}{=} \frac{0 + \omega_0\, j\,\mathrm{sen}(\omega_0 n) - \omega_0 \cos(\omega_0 n) = 1}{+\omega_0}$$

$$D_0 = 1 + \frac{1 - e}{1} = -0{,}71828\,V$$

$$D_1 = \frac{1 - e^{-j\omega_0}}{j\omega_0} + \frac{1 - e^{1-j\omega_0}}{1 - j\omega_0} = \frac{1 - (\cos 2\pi - j\,\mathrm{sen}\,2\pi)}{j2\pi} + \frac{1 - e(\cos 2\pi - j\,\mathrm{sen}\,2\pi)}{1 - j2\pi}$$

$$= \frac{1 - 1}{j2\pi} + \frac{1 - e\,(1 + j2\pi)}{1 - j2\pi\,(1 + j2\pi)} = \frac{1 - j2\pi - e - ej2\pi}{1 + 4\pi^2}$$

$$= \frac{(1 - e) + j(2\pi - 2\pi e)}{1 + 4\pi^2} = -0{,}04246 - 0{,}2667\,j$$

$$D_{-1} = \frac{1 - e^{j\omega_0}}{-j\omega_0} + \frac{1 - e^{1+j\omega_0}}{1 + j\omega_0} = \frac{1 - (\cos 2\pi + j\,\mathrm{sen}\,2\pi)}{-j2\pi} + \frac{1 - e\,(\cos 2\pi + j\,\mathrm{sen}\,2\pi)}{1 + j2\pi}$$

$$= \frac{1 - e\,(1 - j2\pi)}{1 + j2\pi\,(1 - j2\pi)} = \frac{1 - j2\pi - e + ej2\pi}{1 + 4\pi^2} = \frac{(1 - e) + j(2\pi e - 2\pi)}{1 + 4\pi^2}$$

$$= -0{,}04246 + 0{,}2667\,j$$

$$x(t) = \sum_{n=-2}^{2} D_n e^{jn2\pi t} = D_{-2} e^{-j4\pi t} + D_{-1} e^{-j2\pi t} + D_0 + D_1 e^{j2\pi t} + D_2 e^{j4\pi t}$$

$$D_2 = \frac{1 - e^{-j\omega_0 2}}{j\omega_0 2} + \frac{1 - e^{1 - j\omega_0 2}}{1 - j\omega_0 2} = \frac{1 - e^{-j4\pi}}{j4\pi} + \frac{1 - e^{1-4\pi j}}{1 \cdot j4\pi} = \frac{(1 - e^{-4\pi})j + (1 - e \cdot e^{-4\pi})(-4\pi)}{1 + 16\pi^2}$$

$$= \frac{(1-e)(1 + j4\pi)}{1+16\pi^2} = \frac{1 + j4\pi - e - j4\pi e}{1+16\pi^2} = \frac{1 - e + j(4\pi - 4\pi e)}{1 - 16\pi^2}$$

$$D_2 = -0,01081 - 0,13588j$$

$$D_{-2} = -0,01081 + 0,13588j$$

$$x(t) = (-0,01081 + 0,13688j)(e^{-j2\pi t})^2 + (-0,04245 + 0,2667j)e^{-j2\pi t} + 0,71828 + (-0,04245 - 0,2667j)e^{j2\pi t} + (-0,01081 + 0,13588j)e^{j4\pi t}$$

$$= (-0,01081)\left[e^{-j4\pi t} + e^{j4\pi t}\right] + 0,13588j\left[e^{j4\pi t} - e^{-j4\pi t}\right] + (-0,04245)\left[e^{-j2\pi t} + e^{j2\pi t}\right] - 0,2667j\left[e^{j2\pi t} - e^{-j2\pi t}\right] + 0,71828$$

$$= -0,01081 \cdot 2\cos(4\pi t) + 0,13588 \cdot 2\operatorname{sen}(4\pi t) - 0,04245 \cdot 2\cos(2\pi t) + 0,2667\operatorname{sen}(2\pi t) + 0,71828$$

$$= \frac{(0,02162)^2}{2} + \frac{(0,27176)^2}{2} + \frac{(0,08491)^2}{2} + \frac{(0,53334)^2}{2} + 0,71828^2$$

$$P_2 = 0,698895W$$

$P_3 = P_2 + (D_3) + (D_{-3})$

$D_3 = \frac{1 - e^{-j6\pi}}{j6\pi} + \frac{1 - e \cdot e^{-6\pi j}}{1 - j6\pi} = \frac{1 - (e^{-j2\pi})^3}{j6\pi} + \frac{(1 - e \cdot (\cos(6\pi) - j\,\mathrm{sen}(6\pi)))(1+j6\pi)}{(1+j6\pi)}$

$= \frac{1 + j6\pi - e - j6\pi e}{1 + 36\pi^2} = \frac{1 - e}{1 + 36\pi^2} + j\frac{(6\pi - 6\pi e)}{1 + 36\pi^2}$

$D_3 = -0{,}004822 - 0{,}9090j$

$D_{-3} = -0{,}004822 + 0{,}9090j$

$P_3 = P_2 + 2 \cdot (0{,}004822)^2 + 2 \cdot (0{,}9090)^2$

$= 0{,}6985 + 4{,}65 \cdot 10^{-5} + 0{,}016526 = 0{,}71507\ W$

$P_4 = P_3 - (D_4) + (D_{-4})$

$D_4 = \frac{1 - (e^{-j2\pi})^4}{j8\pi} + \frac{1 - e\,(e^{-j2\pi})^4}{1 + j8\pi} = 0 + \frac{(1 - e \cdot (\cos(8\pi) - j\,\mathrm{sen}(8\pi)))(1+j8\pi)}{(1 - j8\pi)(1 + j8\pi)}$

$= \frac{1 + j8\pi - e - j8\pi e}{1 + 64\pi^2} = \frac{1 - e}{1 + 64\pi^2} + j\frac{(8\pi - 8\pi e)}{1 + 64\pi^2}$

$= -0{,}00027160 - 0{,}06826j$

$P_4 = 0{,}71507 + 2 \cdot (0{,}00027160)^2 + 6{,}06826^2 \cdot 2$

$P_4 = 0{,}7244044\ W$

$B = 4\ Hz$