1) # bits : 8
-7.7 - 5 [V]

$x(t) = 20 \sin(7t - \pi/2) - 3\cos(5t) + 2\cos(10t)$

$W_1 = 7$ | $W_2 = 5$ | $W_3 = 10$
$2\pi f\ 7$ | $2\pi f = 5$ | $2\pi f = 10$
$f_1 = 7/2\pi$ | $f_2 = 5/2\pi$ | $f_3 = 10/2\pi$
$f_1 = 1.114\ Hz$ | $f_2 = 0.796\ Hz$ | $f_3 = 1.592\ Hz$

$f_s \geq 2 f_3$

$f_s \geq 3.18\ Hz$

$7 = \frac{2\pi}{T}$

$m = \frac{Y_{max} - Y_{min}}{X_{max} - X_{min}} = \frac{5V + 7.7}{25 - (-25)} = 0.17$

$c = -7.7 - (0.17) \cdot (-25) =$

$\sin(\omega t + \phi)$

$70\ \frac{T}{2\pi} = \frac{1}{7} = \frac{1}{5} = \frac{1}{10}$ 70

$\frac{35}{\pi}\ T = (10 = 14 = 7)$ mcm $= 70$

$T = 2\pi$

2) $f_s = 5\,KHz$

$x(t) = 7\cos(1000\pi t) + 5\sin(2000\pi t) + 10\cos(11000\pi t)$

$$\frac{11000\cancel{\pi}}{2\cancel{\pi}} = F$$

$$5500 \quad f_{max}$$

$$f_s > 2 f_{max} \quad 11\,KHz$$

3) $w_0 = \frac{2\pi}{T}$ $\quad (a-b)^2 = a^2+b^2-2ab$

$$\lim_{T\to\infty} \frac{1}{T} \int_T |x_1(t)-x_2(t)|^2\, dt$$

$$x_2(t) \begin{cases} 1 & si\ 0 \le t \le T/4 \\ -1 & si\ T/4 \le t \le \frac{3}{4}t \\ 1 & si\ \frac{3}{4}t \le t \le T \end{cases}$$

$$\frac{1}{T}\left(\int_0^T x_1^2(t) + \int_0^T x_2^2(t) - 2\int_0^T x_1(t)x_2(t)\right) \qquad x_1(t) = A\cos(w_0 t)$$

$$A^2 \int^T \cos^2(W_0 t)\, dt \qquad u = W_0 t \quad du = W_0$$

$$A^2\left(\int \frac{1}{2} + \int \frac{\cos(2W_0 t)}{2}\right) = \frac{A^2}{2}\left(t + \frac{\overset{\emptyset}{\text{Sen}(\cancel{2}W_0 t)}}{\cancel{2}W_0}\right)\Bigg|_0^T \frac{A^2}{2}(T+0) = \frac{TA^2}{2}$$

$$\int_0^T x_2^2(t)\,dt = \int_0^{T/4} x_2^2(t) + \int_{T/4}^{3/4T} x_2^2(t) + \int_{3/4T}^T x_2^2(t) = \frac{1}{4}T + \left(\frac{3}{4} - \frac{1}{4}\right)T + \left(1 - \frac{3}{4}\right)T = 1T$$

$$2\int_0^T x_1(t)\,x_2(t) = \int_0^{T/4} x_1(t)x_2(t) + \int_{T/4}^{3/4T} x_1(t)x_2(t) + \int_{3/4T}^T x_1(t)x_2(t)$$

$$= \int_0^{T/4} A\cos(W_0 t) + \int_{T/4}^{3/4T} A\cos(W_0 t) + \int_{3/4T}^T A\cos(W_0 t) = A\left(\frac{\text{Sen}(W_0 t)}{W_0} - \frac{\text{Sen}(W_0 t)}{W_0} + \frac{\text{Sen}(W_0 t)}{W_0}\right)$$

$$\frac{2A}{W_0}\left(\text{Sen}(W_0 t)\Big|_0^{T/4} - \text{Sen}(W_0 t)\Big|_{T/4}^{3/4T} + \text{Sen}(W_0 t)\Big|_{3/4T}^T\right)$$

$$(\text{Sen}(\pi/2) - \cancel{\text{Sen}\,0}) - (\text{Sen}(3\pi/2) - \text{Sen}(\pi/2)) + (\cancel{\text{Sen}(2\pi)} - \text{Sen}(3\pi/2)) = \frac{2A}{W_0}(1+2+1)$$

$$\frac{8A}{W_0} = \frac{8TA}{2\pi} = \frac{4}{\pi}TA$$

$$\frac{1}{\cancel{T}}\left(\frac{\cancel{T}A^2}{2} + 1\cancel{T} - \frac{4}{\pi}\cancel{T}A\right)$$

$$\lim_{T\to\infty}\left(\frac{A^2}{2} \pm \frac{4}{\pi}A + 1\right) = d(X_1 - X_2)$$

$$d(X_1 - X_2) = \left(\frac{A^2}{2} - \frac{4}{\pi}A + 1\right)$$

4)

a) $$x(t) = \sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t}$$

$$x'(t) = \sum_{n=-\infty}^{\infty} (jn\omega_0) e^{jn\omega_0 t} C_n \qquad x''(t) = \sum_{n=-\infty}^{\infty} (jn\omega_0)^2 e^{jn\omega_0 t} C_n$$

$$x''(t) = -\sum_{n=-\infty}^{\infty} n^2 \omega_0^2 C_n e^{jn\omega_0 t}$$

$$\int_{t_i}^{t_f} x''(t) e^{-jm\omega_0 t} dt = -\sum_{n=-\infty}^{\infty} n^2 \omega_0^2 C_n \int_{t_i}^{t_f} e^{j(n-m)\omega_0 t} dt$$

Por ortogonalidad

$$\int_{t_i}^{t_f} e^{j(n-m)\omega_0 t} dt = \begin{cases} t_f - t_i & \text{si } n = m \\ 0 & \text{si } n \neq m \end{cases}$$

$$\int_{t_i}^{t_f} x''(t) e^{-jm\omega_0 t} dt = -m^2 \omega_0^2 C_m (t_f - t_i) \Rightarrow C_n = \frac{1}{(t_f - t_i) m^2 \omega_0^2} \int_{t_i}^{t_f} x''(t) e^{jm\omega_0 t} dt$$

b) $$a_n = \frac{2}{(t_f - t_i) n^2 \omega_0^2} R\left\{ \int_{t_i}^{t_f} x''(t) e^{-jn\omega_0 t} dt \right.$$

$$b_n = \frac{2}{(t_f - t_i) n^2 \omega_0^2} I \int_{t_i}^{t_f} x''(t) e^{-jn\omega_0 t} dt$$

Norma