جامعة بيرزيت
BIRZEIT UNIVERSITY

Faculty of Engineering and Technology

Electrical and Computer Engineering

DSP (Fall 2015)

Quiz (3)

Name: key ID:

An analogue signal $x(t) = \cos(400\pi t) + 2\cos(800\pi t)$ is sampled at 600 samples per second.

[3] 1- Determine the Nyquist sampling rate for x(t)?
[3] 2- What are the digital frequencies, in radians, in the resulting discrete-time signal x[n]?
[4] 3- What is the analogue signal, y(t), we can reconstruct from the samples, if we use an ideal D/A converter?

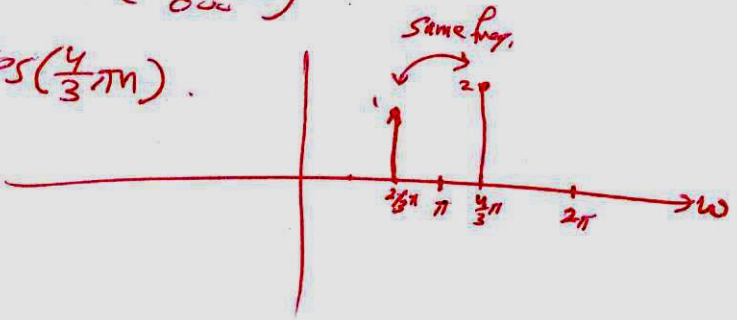
(1) Nyquist Rate $= 2 * \Omega_{max} = 2 * 800\pi = 1600\pi$ rad/sec or 800 Hz.

(2) $x(n) = x(nT)$, $T = \frac{1}{600}$ sec., $f_s = 600$ Hz

$$x(n) = \cos\left(\frac{400\pi n}{600}\right) + 2\cos\left(\frac{800\pi n}{600}\right)$$

$$= \cos\left(\frac{2}{3}\pi n\right) + 2\cos\left(\frac{4}{3}\pi n\right).$$

freq. at $\frac{2}{3}\pi$ is same $\frac{4}{3}\pi$.

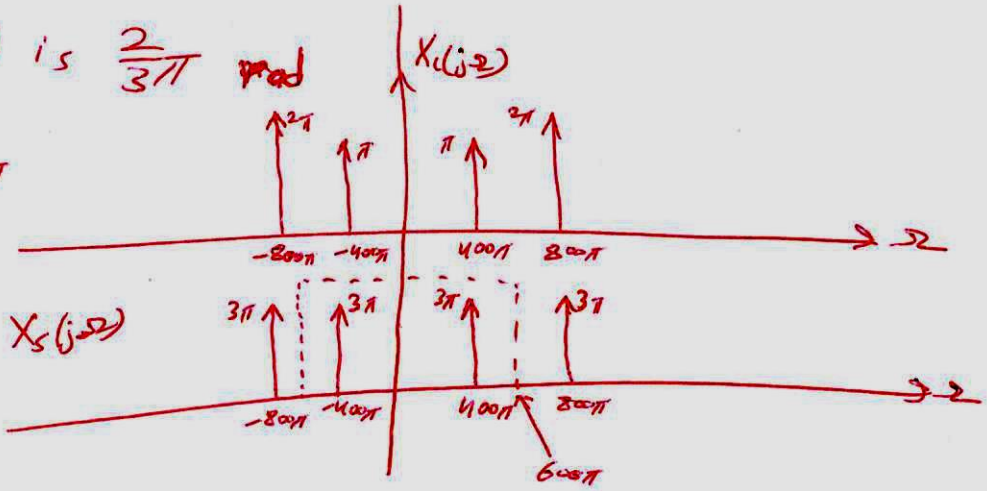


So, $x(n) = 3\cos\left(\frac{2}{3}\pi n\right)$.

digital freq. (ω) is $\frac{2}{3}\pi$ rad

(3) $\Omega_s = 2\pi(600) = 1200\pi$

$\Omega_c = \frac{\Omega_s}{2} = 600\pi$



$\Rightarrow y_r(t) = 3\cos(400\pi t)$.

Quiz (3) key

$x_c(t) = 3\cos(20\pi t) + 5\cos(60\pi t) + 10\cos(120\pi t)$

(1) [3] Nyquist rate $= 2 * f_{max} = 2 \times 60 = 120$ Hz.

or

$\Omega_s = 240\pi$ rad/sec

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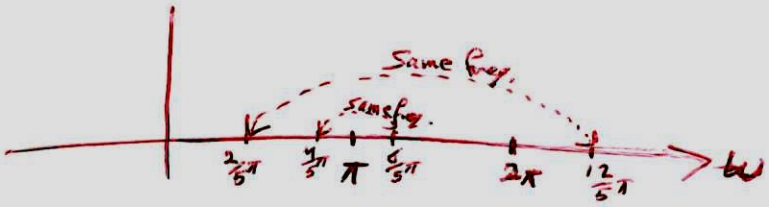
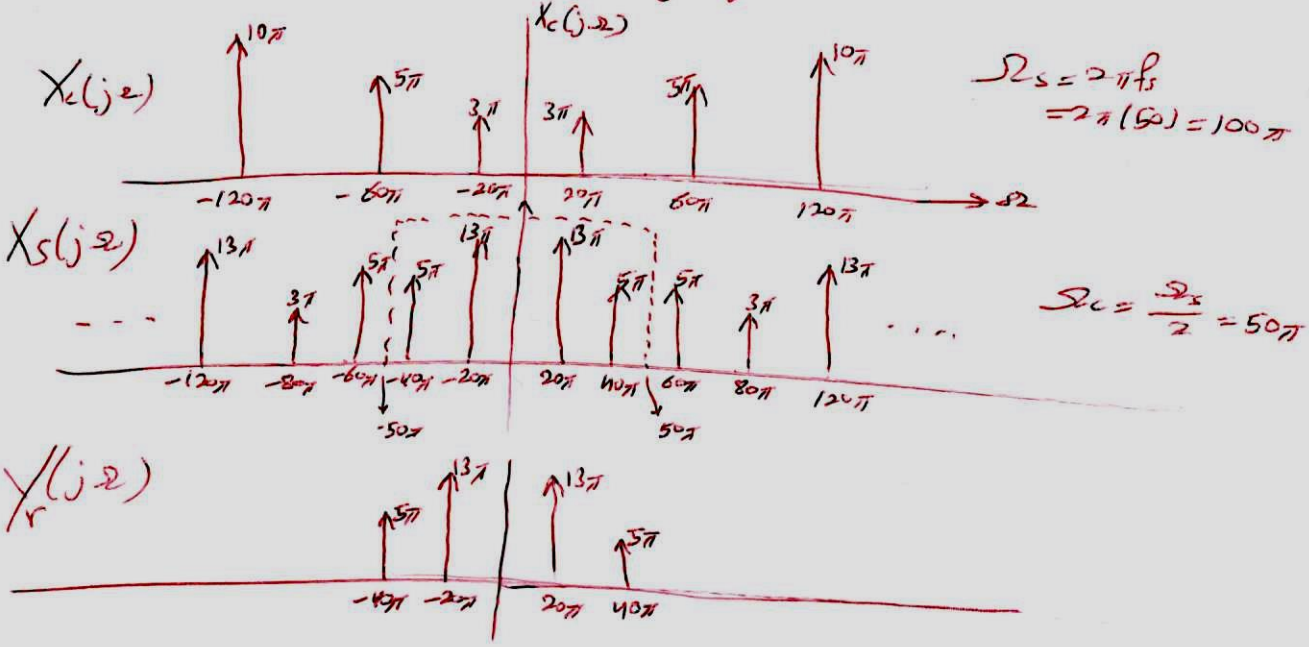
(2) [3] $x(n) = x_c(nT) = 3\cos\left(\frac{20}{50}\pi n\right) + 5\cos\left(\frac{60}{50}\pi n\right) + 10\cos\left(\frac{120}{60}\pi n\right)$

$= 3\cos\left(\frac{2}{5}\pi n\right) + 5\cos\left(\frac{6}{5}\pi n\right) + 10\cos\left(\frac{12}{5}\pi n\right)$



So, $x(n) = 13\cos\left(\frac{2}{5}\pi n\right) + 5\cos\left(\frac{4}{5}\pi n\right)$.

(3) [4]



So, $y(t) = 13\cos(20\pi t) + 5\cos(40\pi t)$.