

Assignment

$$x_c(t) = \cos(50\pi t) \quad f_s = 30 \text{ Hz}$$

a). $x(n)$ after sampled at $f_s = 30 \text{ Hz}$

$$x(n) = \cos 50\pi n$$

$\left(\text{at } (50\pi)n \right) \text{ rad} \quad \text{and } \text{the to sample value}$

$$\cos \left(2\pi n \left(\frac{5}{3} \right) \right) = \cos \left(2\pi n - \frac{2\pi}{3} \right) = \cos \left[\frac{2\pi n}{3} \right]$$

Therefore

$$x(n) = \cos \left[2\pi n \left[\frac{5}{6} \right] \right] = \cos \left[\frac{\pi n}{3} \right]$$

b) Since $x(n)$ can be written as

$$x(n) = \cos(\omega_0 n)$$

$$\omega_0 = \frac{2\pi}{3} \times (n-1) \text{ rad/s}$$

$$\omega_0 = \frac{\pi}{3} \text{ rad/sample}$$

for fundamental frequency

$$\omega_0 n = 2\pi \times (n-1) \text{ rad/s}$$

$$\frac{\pi n}{3} = 2\pi \times (n-1) \text{ rad/s}$$

$$n = 6$$

fundamental period $n = 6$

c). according to the nyquist theorem $f_s \geq 2f_1$ to be not aliasing

Therefore since $30 < 2 \times 25 \text{ Hz}$ the sampling will cause aliasing.

if we reconstruct the signal back

$$x(t) = \cos(\frac{\pi f_1 t}{3} \times 30)$$

$$= \cos(10\pi t)$$

$$= \cos(2\pi 5t)$$

Therefore aliased frequency = 5 Hz

3.

a). according to the nyquist theorem if a signal has frequency components upto 5 kHz minimal sampling frequency should be 10 kHz to stop aliasing

b). if 15 kHz and 5 kHz components are available $f_s = 30 \text{ kHz}$

c). zero order hold is a reconstruction method where the value of the sample is kept constant when reconstructing until the next sample which will last for T_s time.