NAME:- SHAH RAZA

REG NO:- 18PWCSE1658

SECTION :- B

SUBMITTED TO:- DR. NASIR AHMAD

ASSGNMENT NO:- 1

# QUESTION NO:- 1

1- Consider the analog signal
$x_a(t) = 2\sin(120\pi t)$

2- Sketch Signal $x_a(t)$ in interval $0 \leq t \leq 40$

$\omega = 120\pi$

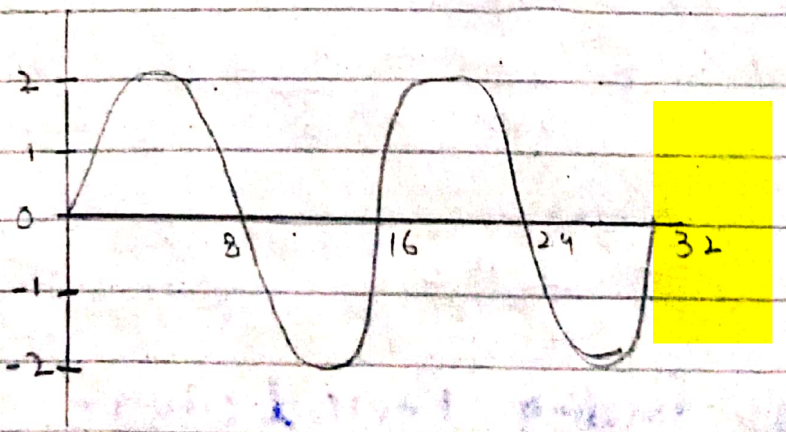
$\omega = 2\pi f$ — Eq (1)

$F = \frac{120\pi}{2\pi} = 60\,Hz$

$t = \frac{1}{60}$

$= 0.96\,Sec$

$t = 16\,ms$



b) if the signal is sampled with sampling frequency $F_s = 360Hz$, find the frequency of resultant or signal.

$x[n] = x_a[nT_s]$ ; $T_s = 1/F_s$

$x_a(t) = 2\sin(120\pi t)$

$x_a(nT_s) = 2\sin(120nT_s)$

$x_a(nT_s) = 2\sin\left(\frac{120n\pi}{F_s}\right)$

Now Discrete Time Signal

$x[n] = 2\sin(2\pi Fn) \longrightarrow Eq(2)$

Comparing Eq (1) & (2)

$\frac{120\pi}{F_s} = 2\pi f$

$= f = \frac{60}{F_s}$

As $F_s = 360$

Then $f = \frac{60}{360} = \frac{1}{6} Hz$

$f = \frac{1}{6} Hz$

**Now finding Periodicity:-**

As $x[n] = 2\sin(2\pi fn)$

$$x[n] = 2\sin\left[2\pi\left(\frac{1}{6}\right)n\right]$$

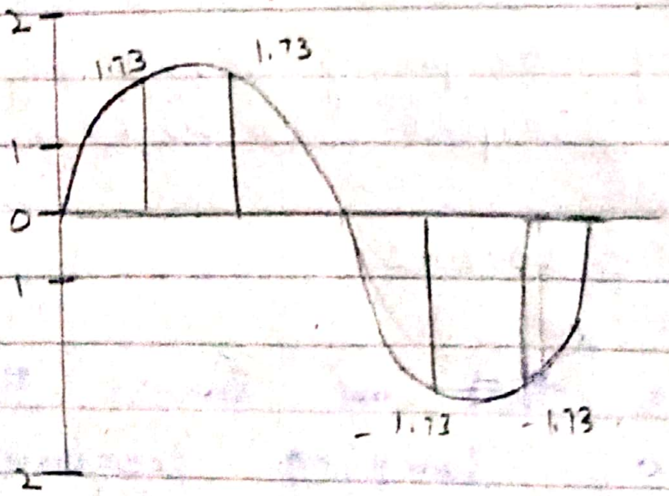
$$x[n] = 2\sin\left(\frac{\pi}{3}n\right)$$

$$f = \frac{\omega}{2\pi} = \frac{\pi/3}{2\pi} = \pi/6\pi = \frac{1}{6} = P/q$$

is a rational number "$\omega$" has factor of $\pi$, So DT signal $x[n]$ is Periodic

As $f = 1/6$ Hz $= 1$

$N = 6$.




Time Period = 16 ms

No of Samples in : 6

**QUESTION NO:- 2**

**An Analog Signal Contains frequency upto 10KHZ. What range of Sampling frequency allow exact reconstruction of this signal from its Sample.**

4KHz

As we have given $F_m = 10\,KHZ$

According to Nyquist Theorem

$F_s \geq 2 \cdot F_m$ ⇒ So for the exact reconstruction of signal in frequency domain

Sampling frequency should be greater than or equal to 20 KHz.

$F_s \geq 20\,KHZ$

**b) Suppose that we Sample this signal with a Sampling frequency $F_s = 8KHz$**

**Examine: what happens to the frequency $F_1 = 5KHZ$**

As we have

$F_s = 8KHz$ , $F_1 = 5KHz$

From $F_s = 8Hz$ we can sample upto 4KHz

$F_{fold} = 4KHz$

So

$8KHz \ngtr 2(5KHz)$

$8KHz \ngtr 10KHz$

As $F_i = 5KHz \Rightarrow \omega = 10\pi$

$\omega' = 10\pi - 2\pi$

$= 8\pi$

$8\pi = 2\pi(4)$

$F_i = 4KHz$

So 5KHz Alais to 4KHz.

**c) Repeat (b) for frequency $F_2$ 9KHz**

$F_s \geq 2(F_m)$

$8KHz \ngeq 2(9KHz)$, $F_2 = 9KHz$

So $\omega_2 = 18\pi$

$\omega_2' = 18\pi - 12\pi$

$F_2' = 3KHz$

9KHz Alais to 3KHz

QUESTION NO:- 3

An Analog Signal $x_a(t) = \sin[(480)\pi t] + 3\sin(720\pi t)$ is Sampled 600 time/sec

a) Determine the Nyquist Sampling rate for $x_a(t)$.

As $F_m = 360$

According to Nyquist theorem.

$F_s \geq 2F_m$.

$F_s \geq 2(360)$ Hz

$F_s \geq 720$ kHz.

b) Determine the folding frequency

folding Frequency.

$F_{fold} = \frac{F_s}{2}$

$= \frac{600}{2} = 300$

Hence folding Frequency $= 300$ Hz

Scanned with CamScanner

c) What are the frequency in radian, resulting or signal $x[n]$ ?

$$x[n] = \sin(480\pi n) + 3\sin(720\pi n)$$

$$= \sin\left(\frac{480\pi n}{600}\right) + 3\sin\left(\frac{720}{600}\pi n\right).$$

$$= \sin\left(\frac{4}{5}\pi n\right) + 3\sin\left(\frac{6}{5}\pi n\right)$$

$$= \sin\left(\frac{4}{5}\pi n\right) + 3\sin\left(-\frac{4}{5}\pi n\right)$$

$$= \sin\left(+\frac{4}{5}\pi n\right) - 3\sin\left(\frac{4\pi n}{5}\right)$$

$$x[n] = -2\sin\left(\frac{4\pi}{5}n\right)$$

Frequency

$$\omega = \frac{4\pi}{5} \text{ rad/sec}$$

d) if $x[n]$ is passed through ideal D/A converter, what is reconstructed signal $x_a(t)$?

Scanned with CamScanner

$$y_a(t) = x(F_s t)$$

$$= -2\sin\left(\frac{4\pi}{5}(600)t\right)$$

$$y_a(t) = -2\sin(480\pi t)$$

QUESTION NO:- 4

The discrete time signal $x[n] = 6.35\cos\left(\frac{\pi n}{10}\right)$ is quantized with a resolution

a) $\Delta = 0.1$ (b) $\Delta = 0.2$

How many bits are required in the A/D converter in each case

Sol:-

As $\Delta = 0.1$

Now According to the formula

$$\Delta = \frac{x_{max} - x_{min}}{L - 1}$$

$$\Delta L - \Delta = x_{max} - x_{min}$$

$$L = \frac{x_{max} - x_{min} + \Delta}{\Delta}$$

Scanned with CamScanner

Putting values

$$L = \frac{6.35 - (-6.35) + 0.1}{0.1}.$$

$$L = 128 \qquad (\because L = 2^b)$$

$$2^b = 2^7$$
$$b = 7 \text{ bits}.$$

7 bits is required when $\Delta$ is 0.1.

**b)** According to formula.

$$L = \frac{X_{max} - X_{min} + \Delta}{\Delta}.$$

$\Delta = 0.02$, $X_{max} = 6.35$. $X_{min} = -6.35$

$$L = \frac{6.35 - (-6.35) + 0.02}{0.02}.$$

$$L = 636 \quad (\because L = 2^b).$$

$$2^b = 636$$

Taking log both sides.

$b \log 2 = \log 636$

$$b = \frac{\log 636}{\log 2}$$

$b = 9.3$

$b = 10$ bit.