AL- MUSTAQBAL UNIVERSITY COLLEGE
DEPARTMENT OF BIOMEDICAL ENGINEERING

# Digital Signal Processing (DSP)

## BME 312

## Lecture 3

## - Type of Signals -

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# Basic Signals



- Sinusoidal Signal.
- Exponential Signal.
- Unit Step Function.
- Unit Ramp Function.
- Unit Impulse Function.

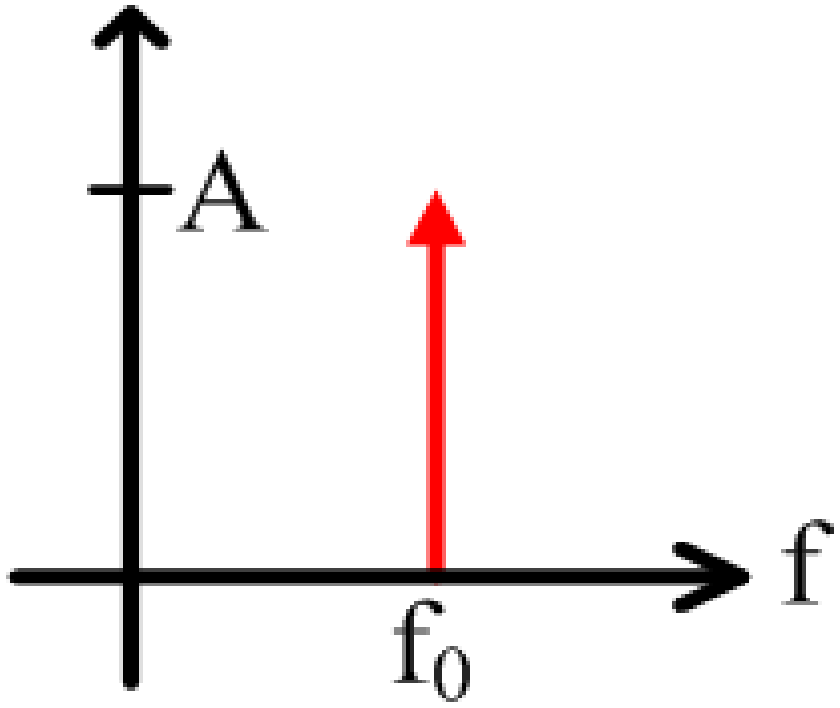
# Sinusoidal Signal Properties

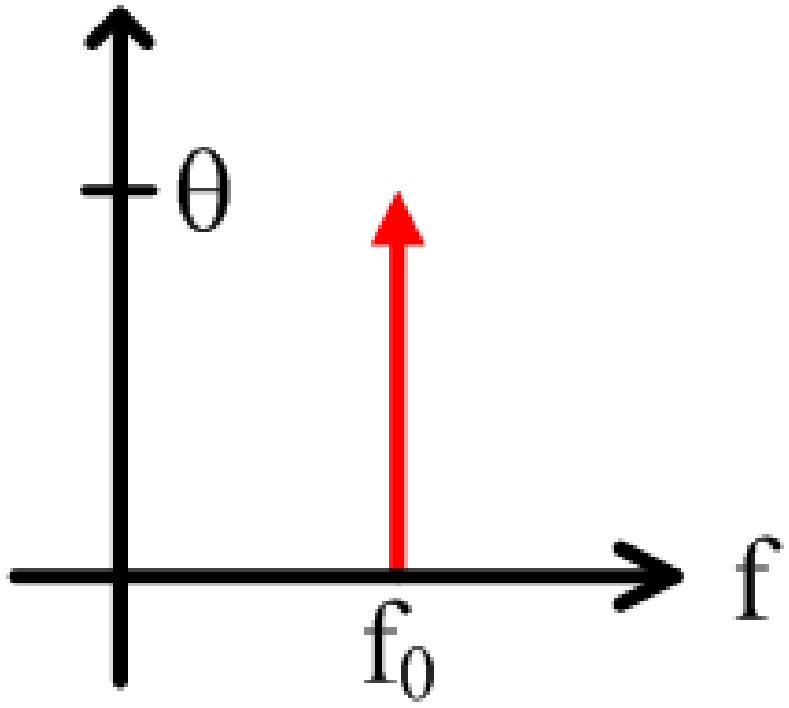


- Frequency.
- Period.
- Peak (maximum) value.
- Peak-to-peak value.

# Amplitude & Phase Spectrums

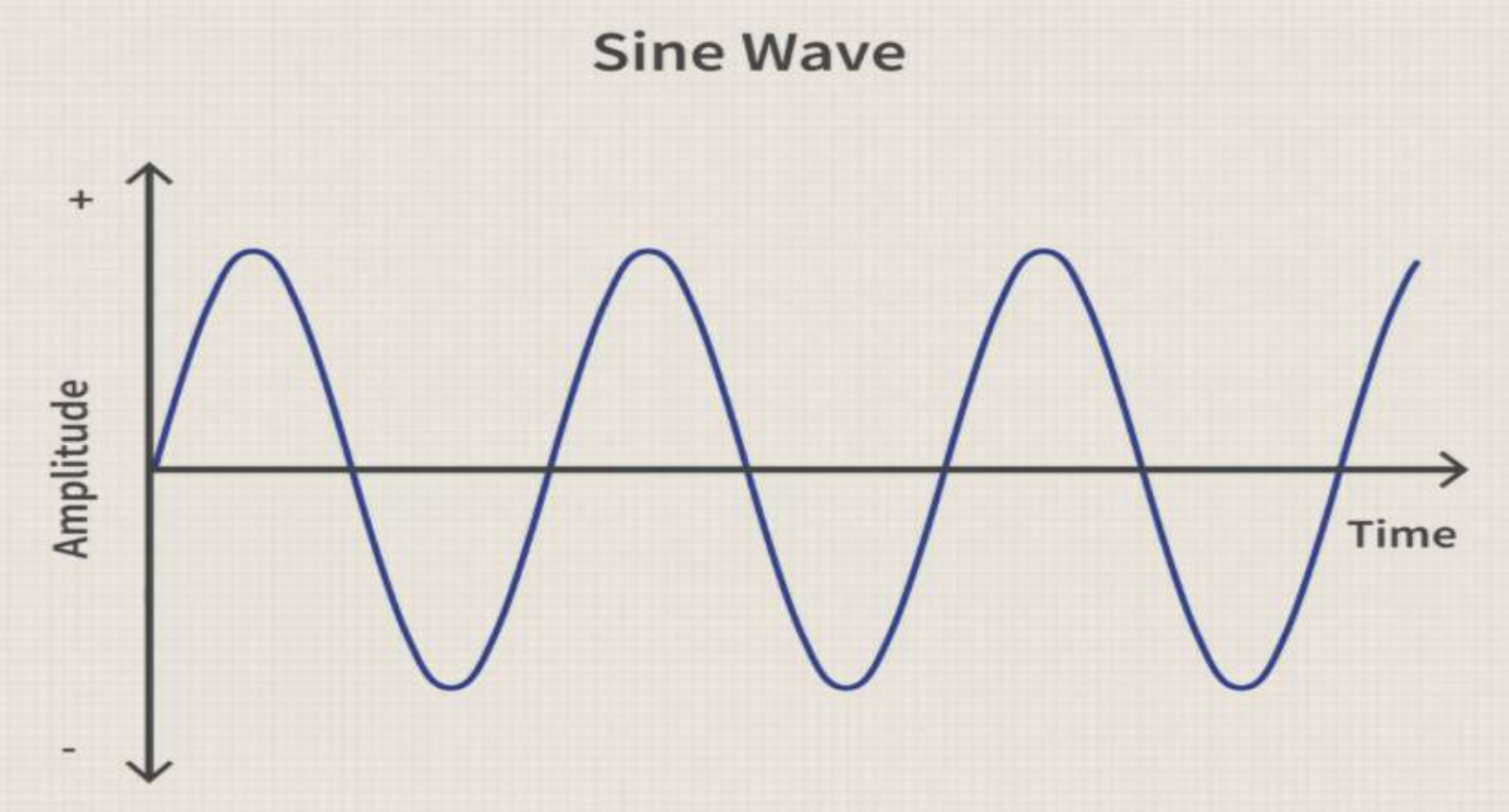




# Sin Signal



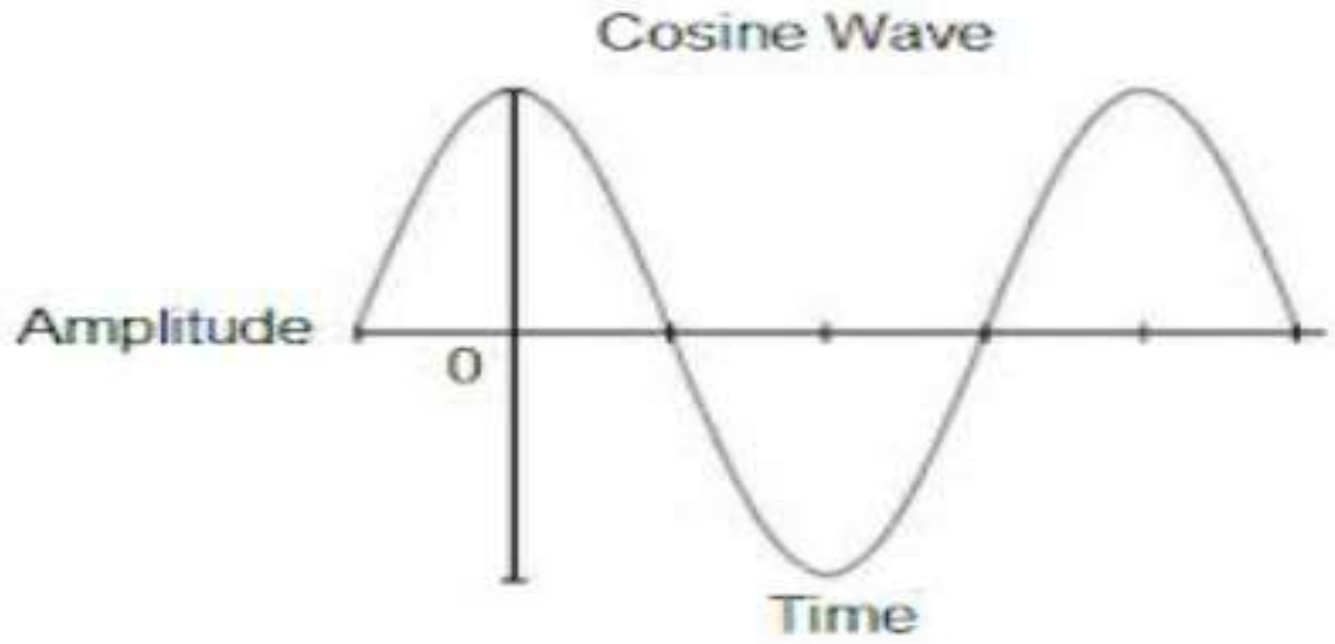



$$x(t) = A \sin(\omega_0 t + \theta)$$

$$x(t) = A \sin(2\pi f_0 t + \theta)$$

# Cos Signal






$$x(t) = A \cos(\omega_0 t + \theta)$$

$$x(t) = A \cos(2\pi f_0 t + \theta)$$

Where

A : is the amplitude (real),

$w_o$ : is the radian frequency in radians per second, and

$\theta$ : is the phase angle in radians.

Where wo is called the fundamental angular frequency.

$$\omega_0 = 2\pi f_0$$

The reciprocal of the fundamental period To is called the fundamental frequency fo:

$$f_0 = \frac{1}{T_0} \quad \text{hertz (Hz)}$$

$$T_0 = \frac{2\pi}{\omega_0}$$

# Example

Sketch a waveform for a signal.

$$\mathbf{x(t) = 10 \sin (50 \pi t + 0)}$$

Sol :

$x(t) = 10 \sin (50 \pi t + 0)$

$\Rightarrow$ $10 \sin (2\pi (25) t + 0)$

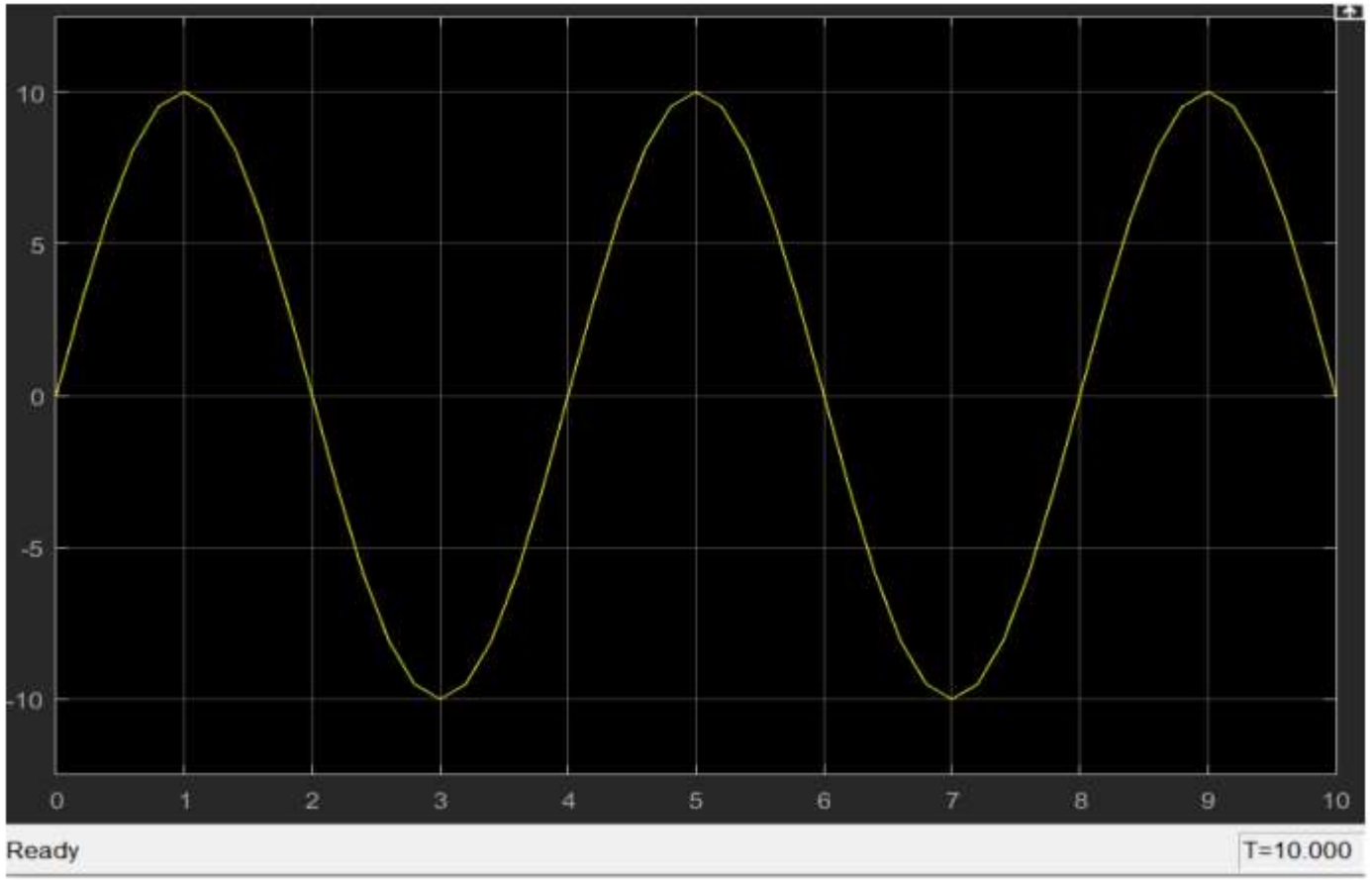
$\Rightarrow$ $T = 1/25$ s

$\therefore$ $f =$ **25 Hz** ##

# Example



$$x(t) = 10 \sin (50 \pi t + \pi/6)$$



# Example



Sketch a waveform for a signal, x(t) = 5 sin 377 t with time in seconds.

Sol:

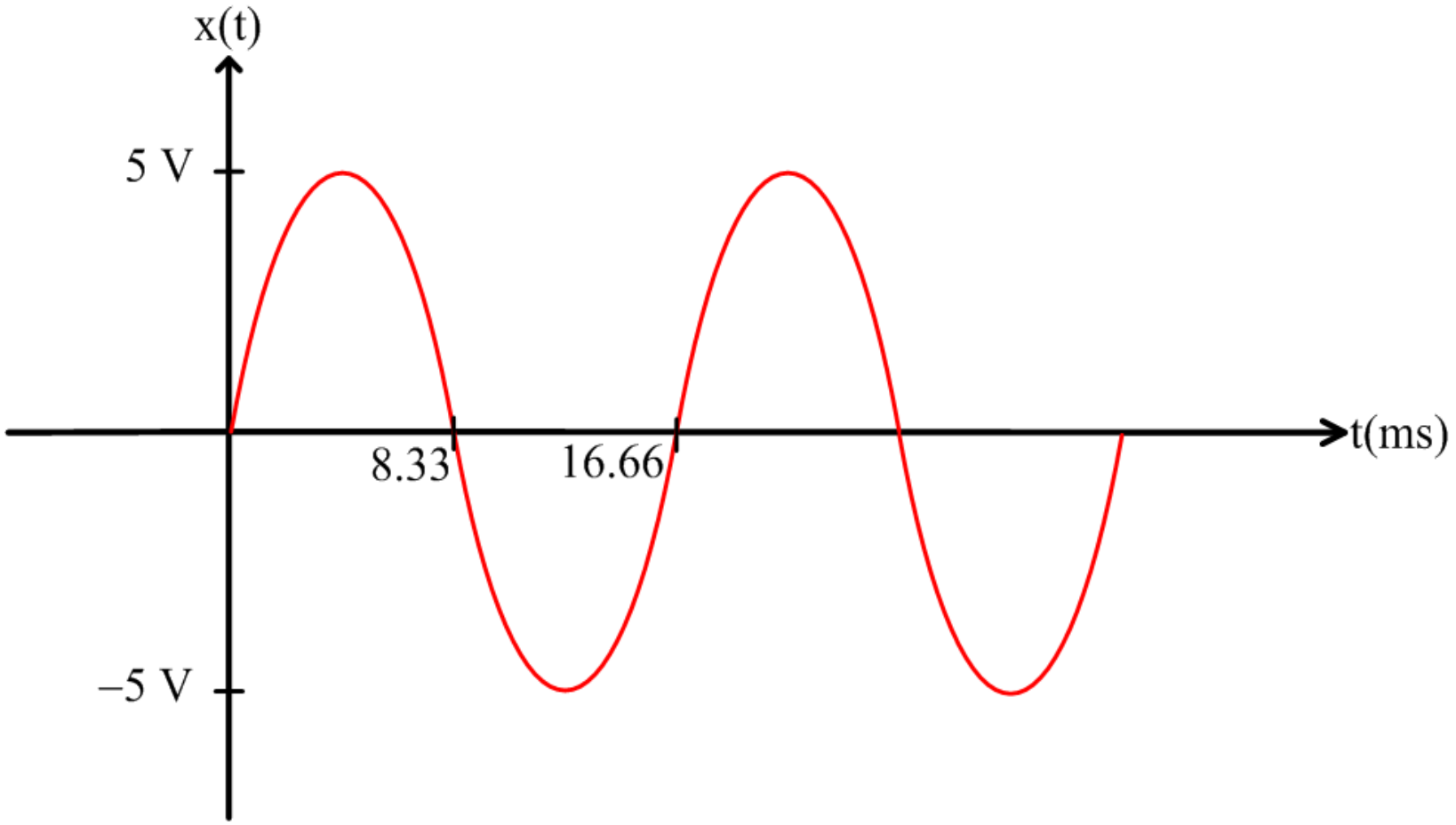
Peak (maximum) value, $A_{(p)} = 5$.

Frequency, $f = 377/(2\pi) = 60$ Hz.

Period, $T = 1/f = 1/60$ Hz $= 16.66$ ms.

# Example

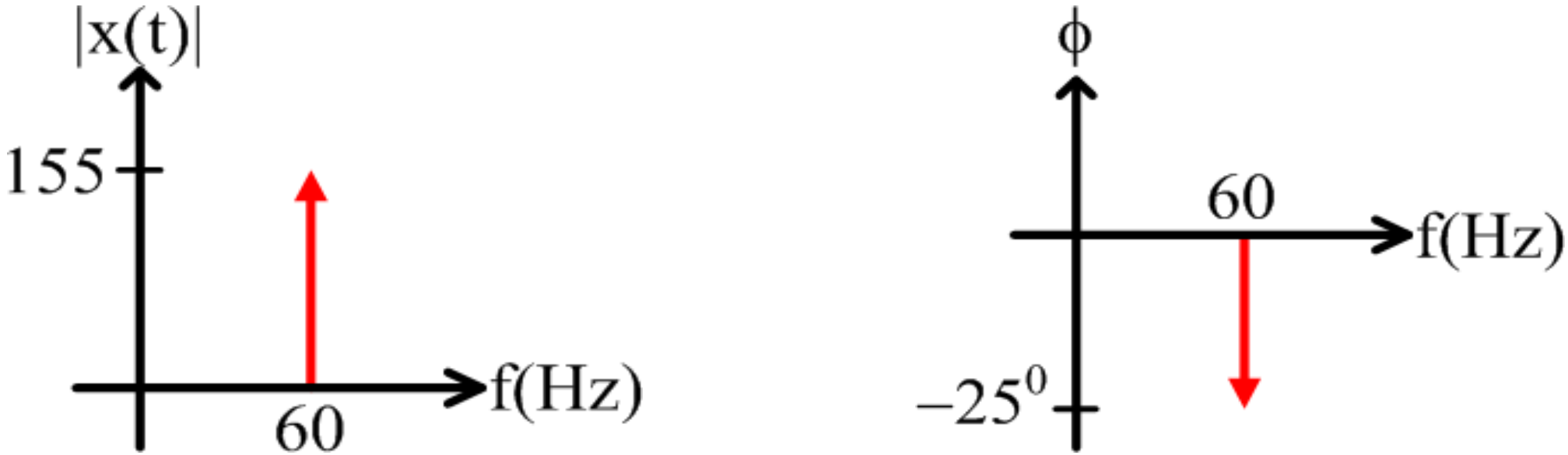




# Example



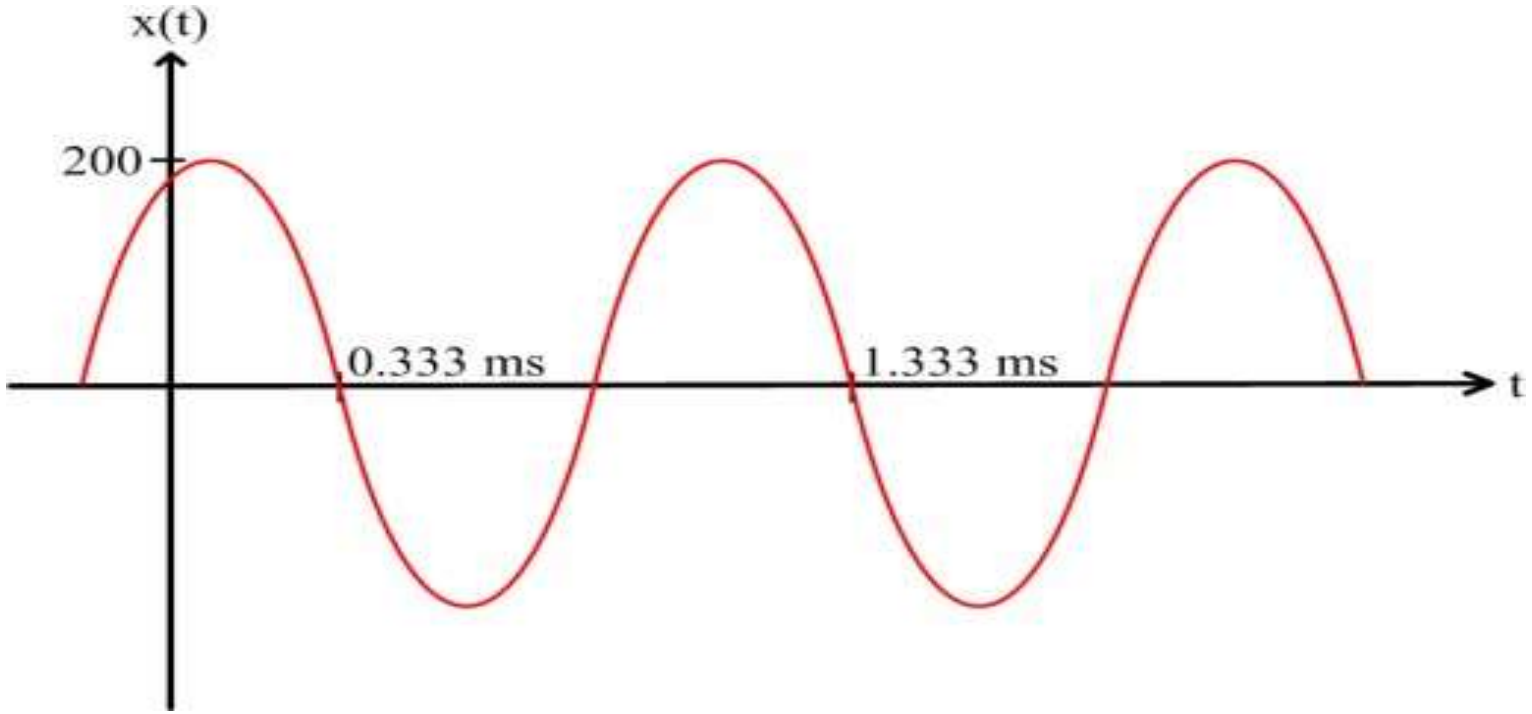
Represent $x(t) = 155 \cos(377t - 25^0)$ in frequency domain.



# Example



Write the analytical expression for the signal with the phase angle in degrees.



# Example



Write the analytical expression for the signal with the phase angle in degrees.

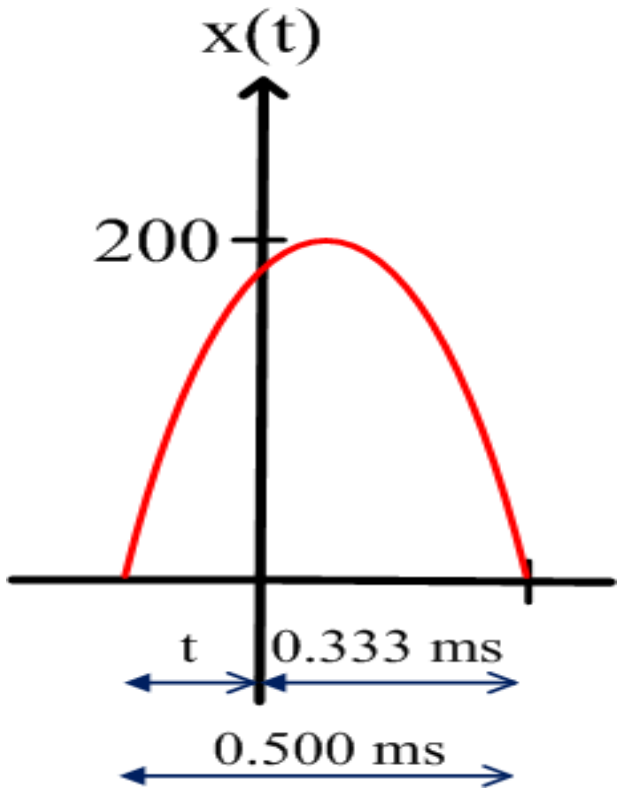
Peak (maximum) value, $A_{(p)} = 200$.

Period, T = 1.333 ms – 0.333 ms = 1 ms.

Frequency = 1/T = 1/1 ms = 1 kHz.

# Example






$$t = 0.500\ ms - 0.333\ ms$$

$$= 0.167\ ms$$

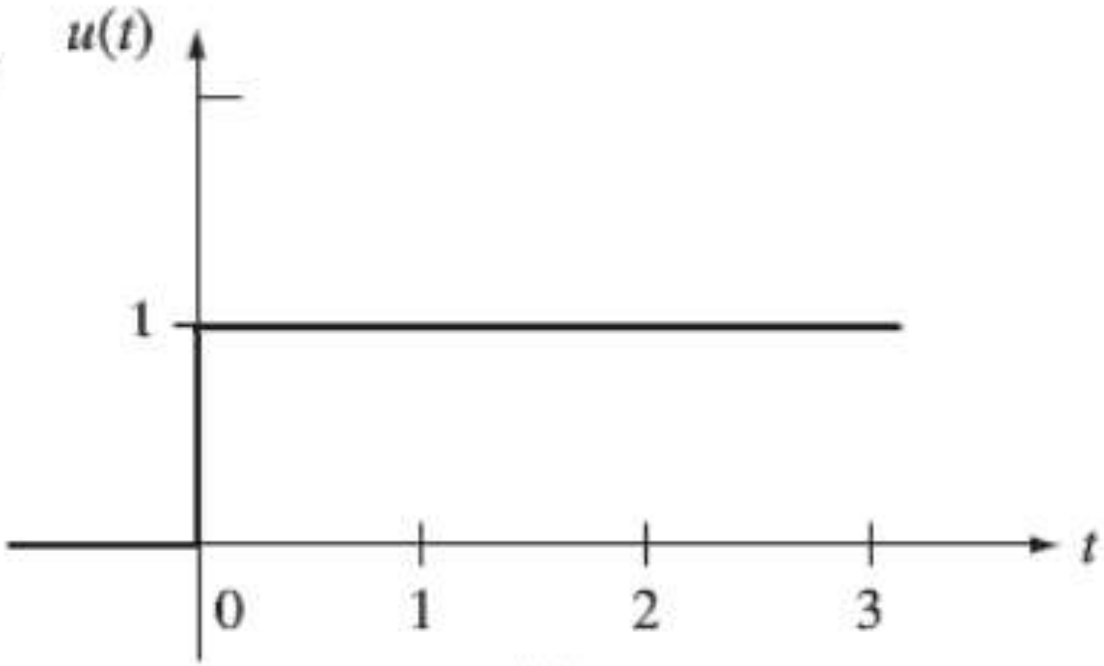
$$0.167\ ms = (0.167\ ms / 0.500\ ms)180^0$$

$$= 60.12^0$$

$$x(t) = 200 \sin (2\pi 1000t + 60.12^0)$$

# Unit-step function u(t)

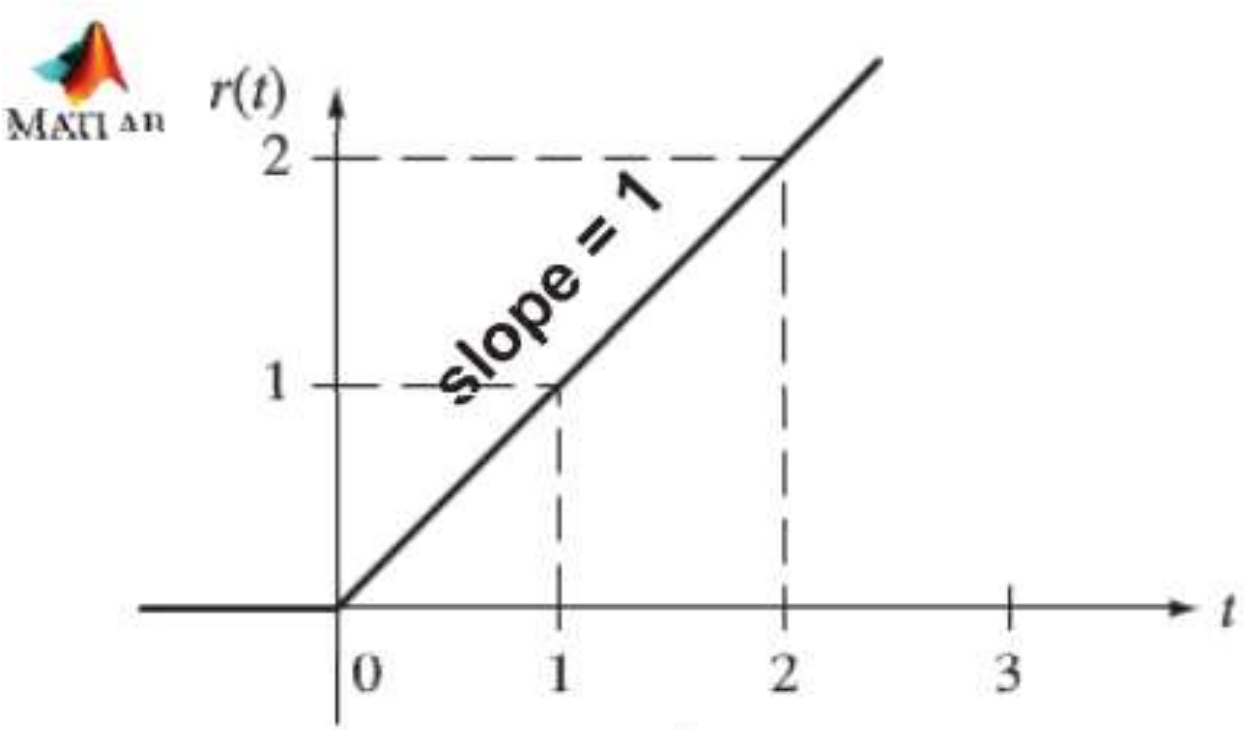





$$u(t) = \begin{cases} 1, & t \geq 0 \\ 0, & t < 0 \end{cases}$$

# Unit-ramp function r(t)

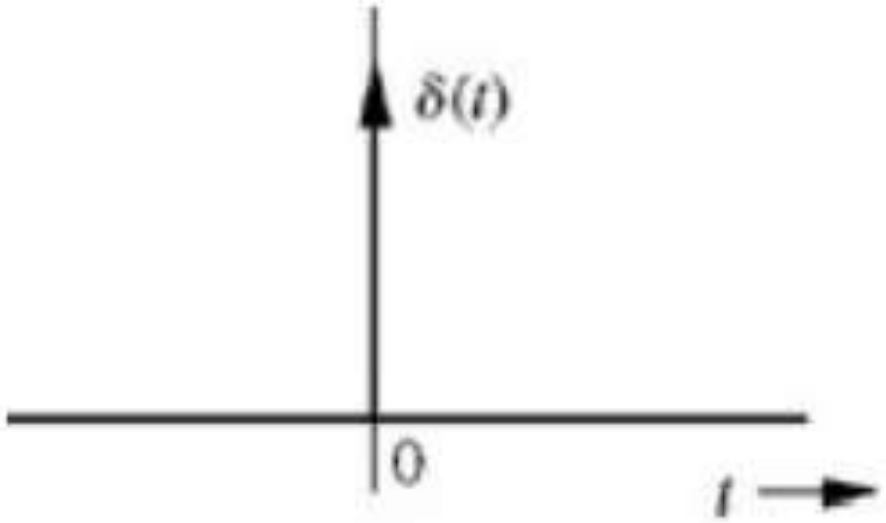





$$r(t) = \begin{cases} t, & t \geq 0 \\ 0, & t < 0 \end{cases}$$

# Unit impulse function






$$\delta[n] = \begin{cases} 1 & n = 0 \\ 0 & n \neq 0 \end{cases}$$