COLLEGE OF ENGINEERING AND TECHNOLOGIES
ALMUSTAQBAL UNIVERSITY

Digital Signal Processing (DSP)

CTE 306

Lecture 5

- Continuous Time Signal -

(2023 - 2024)

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Lecturer / Researcher

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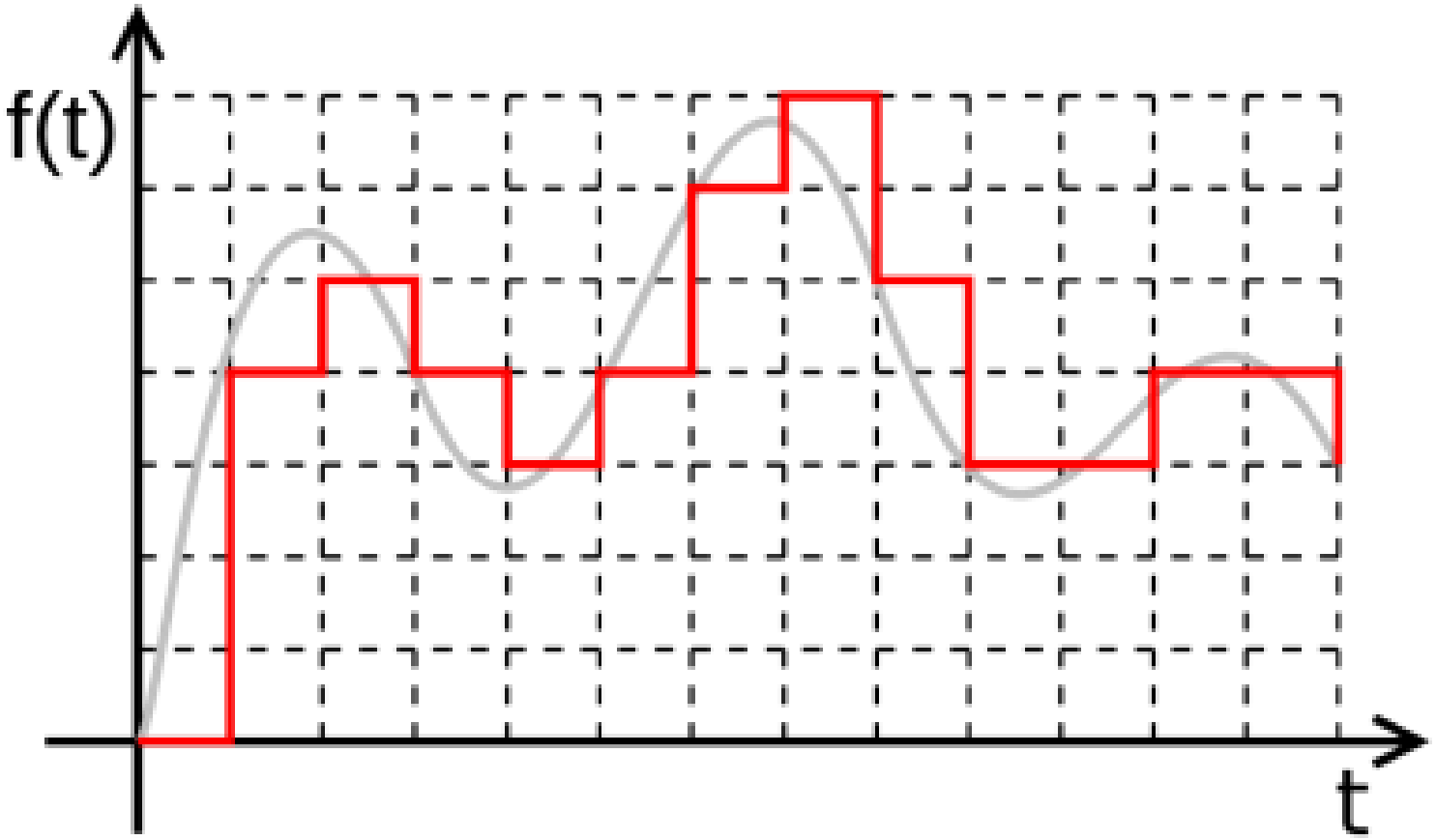
Continuous Time Signal

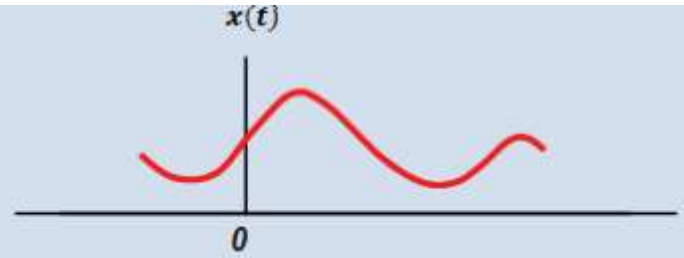


Transformations of time: Time-Shifted Signals

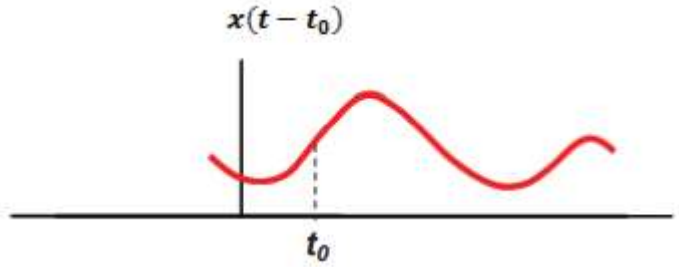
To consider the time-shifted version of x(t), use the following rules:

The signal $x(t - t_0)$ is x(t) shifted to the right by t_0 seconds.

Original



Delayed

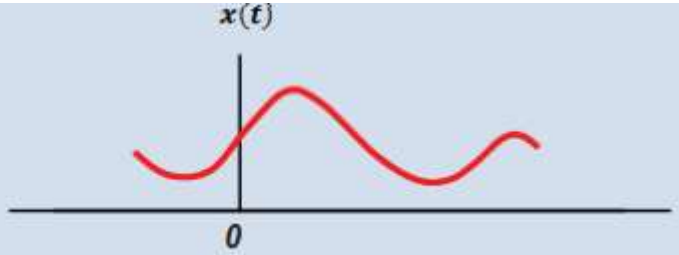


Transformations of time: Time-Shifted Signals

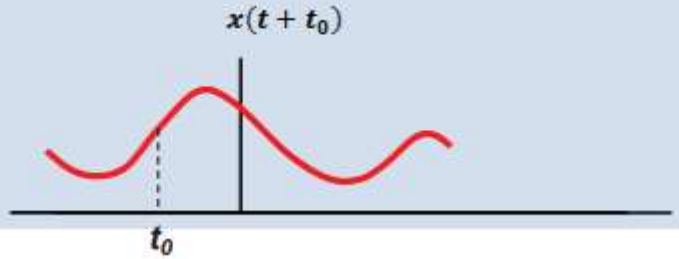
To consider the time-shifted version of x(t), use the following rules:

The signal $x(t + t_0)$ is x(t) shifted to the left by t_0 seconds.

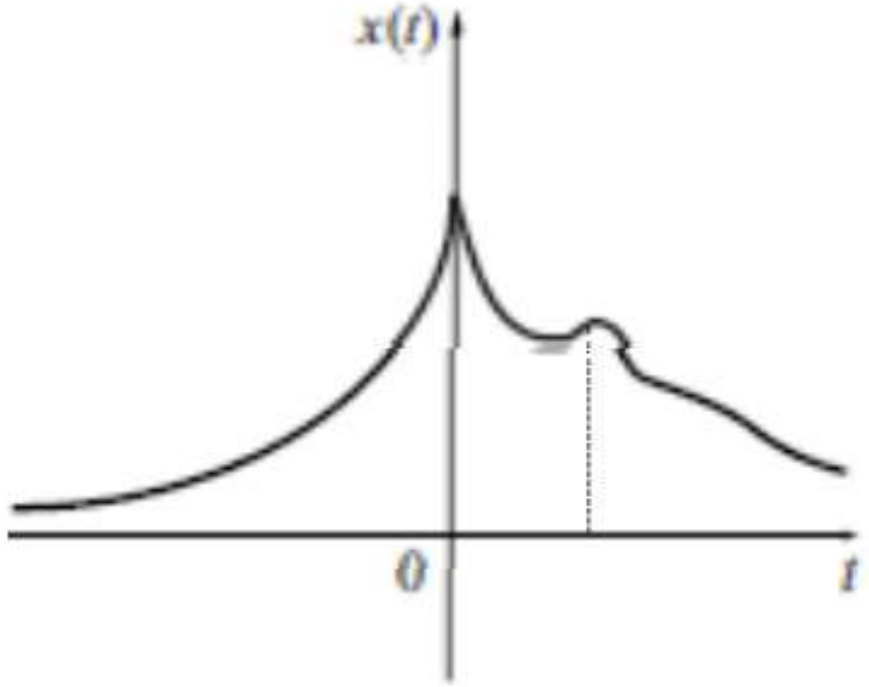
Original

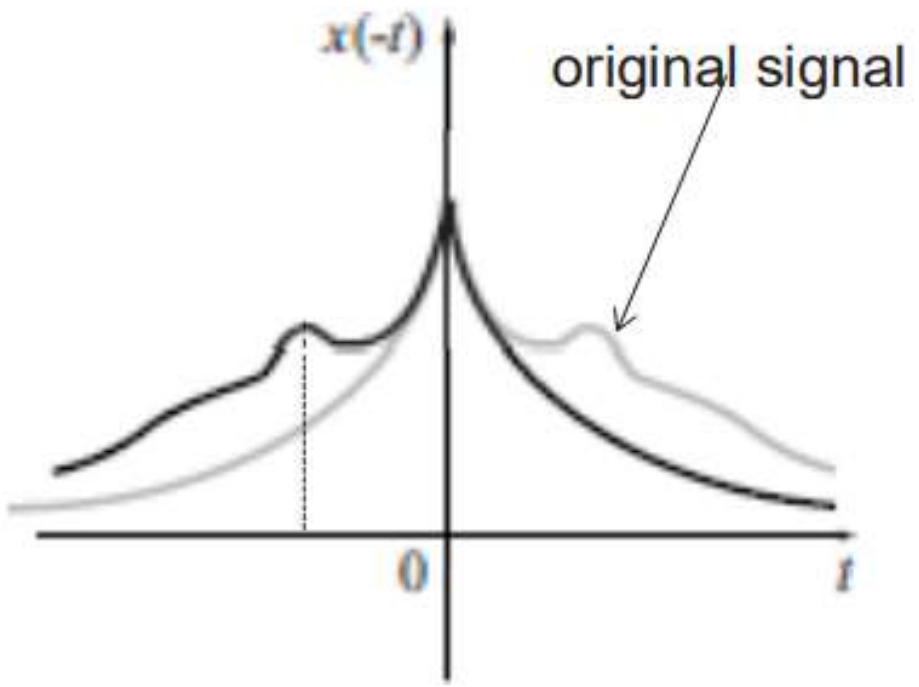


Advanced

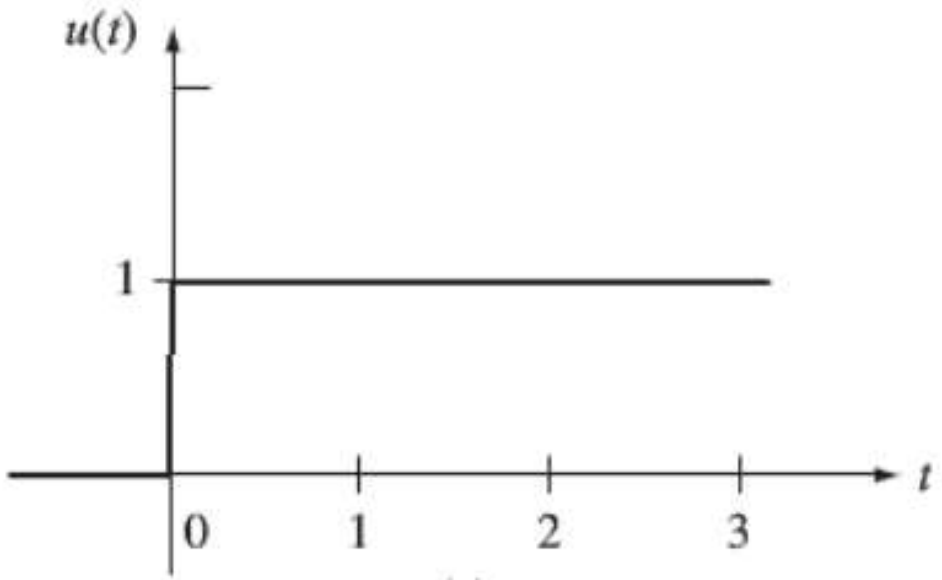


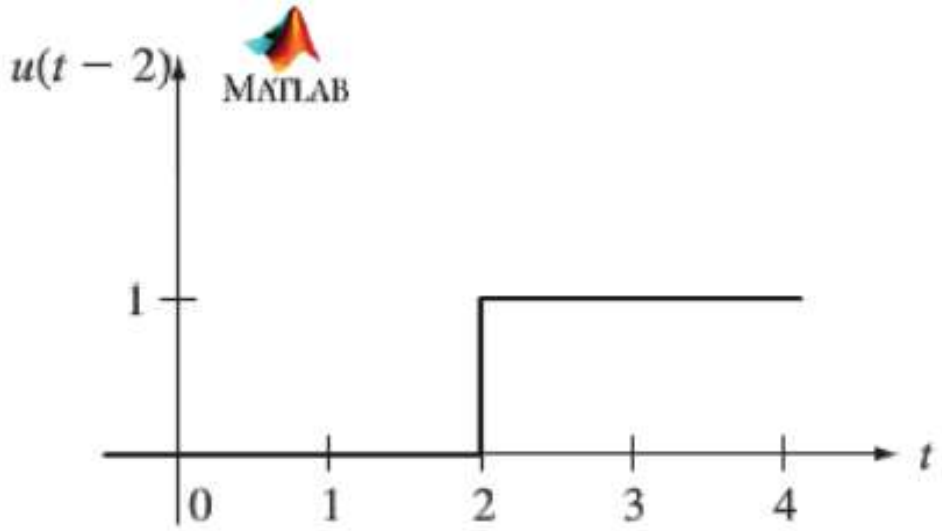
Transformations of time: Time reversal (Reflection)





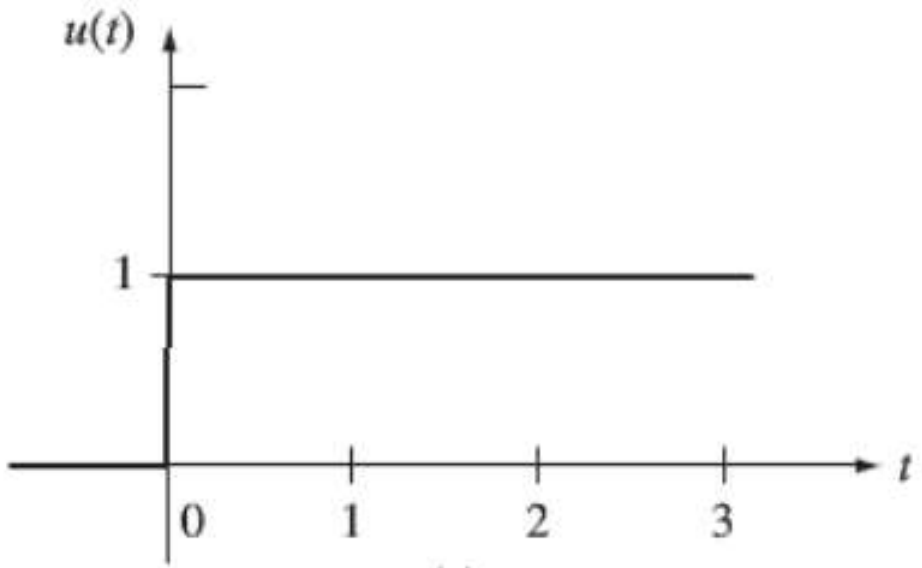
Delayed

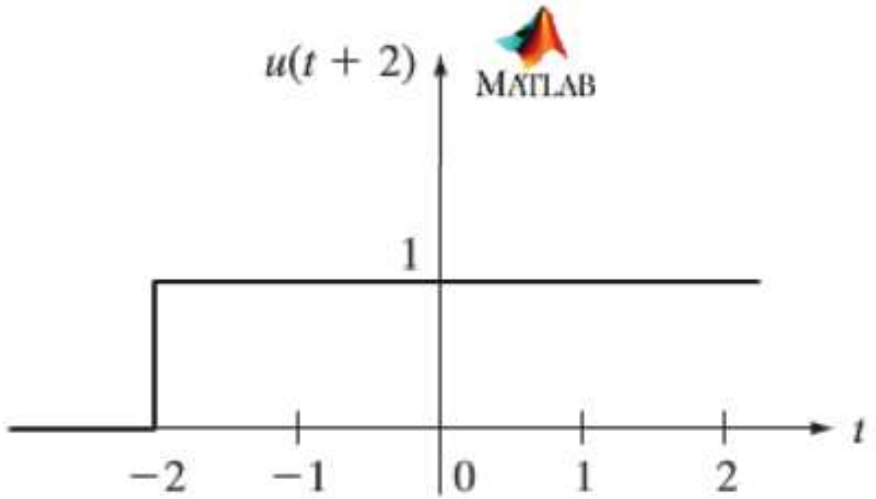




2 second right shift of u(t)

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



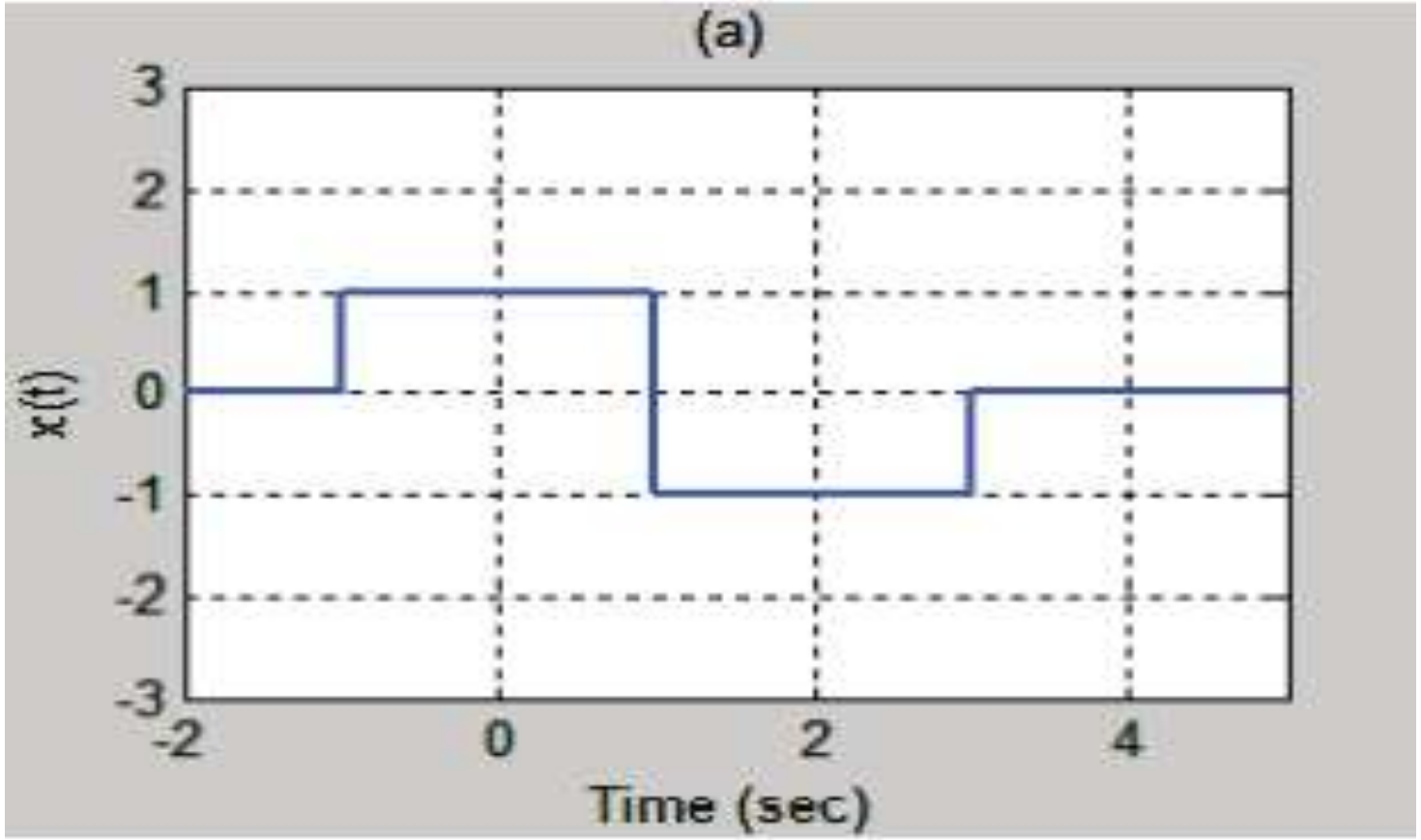


2 second left shift of u(t)

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

Example 1

$$x(t) = u(t+1) - 2u(t-1) + u(t-3)$$



Example 2

Sketch a waveform for a signal.

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

Sol :

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

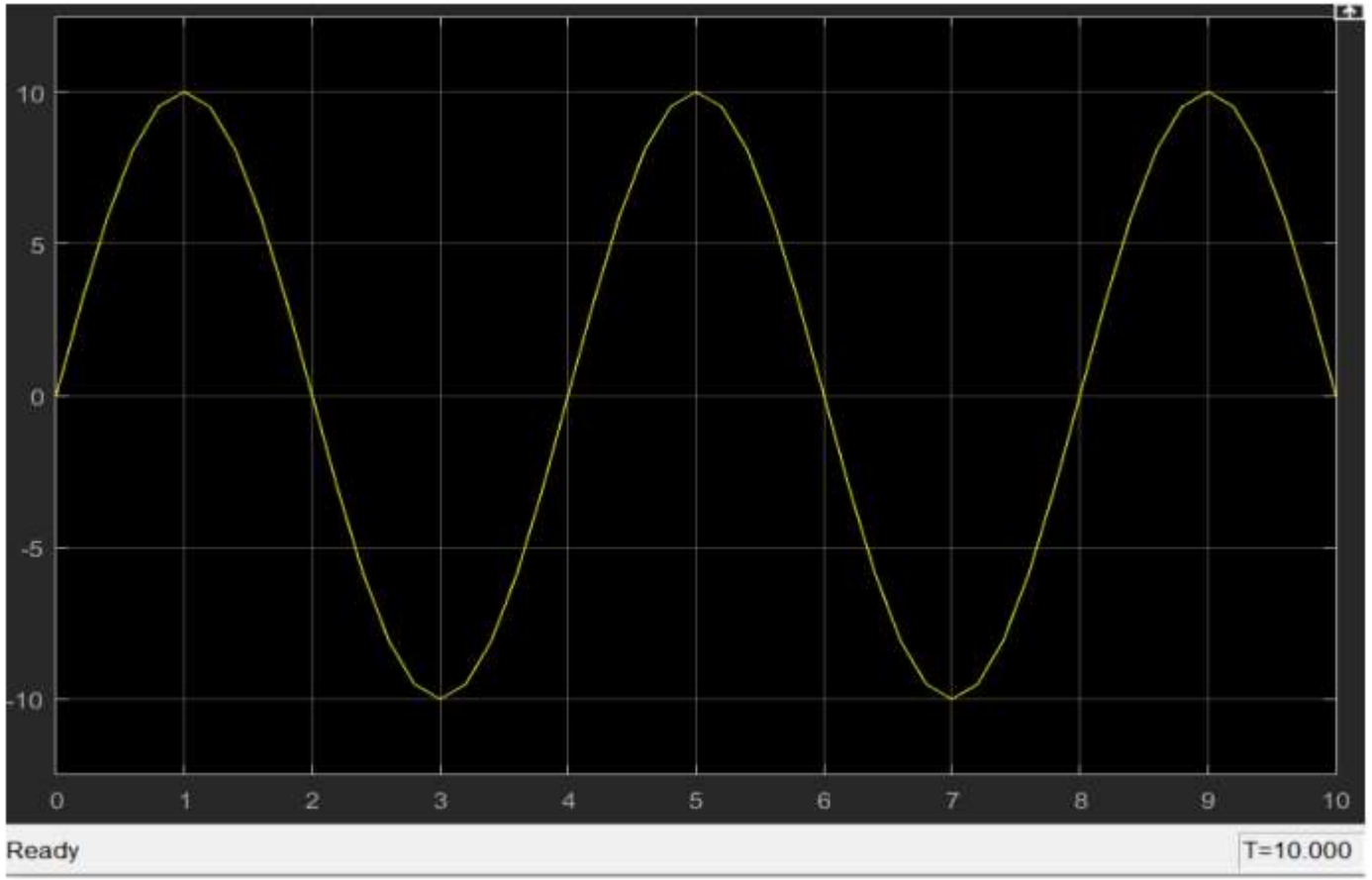
$10 \sin (2\pi (25) t + 0)$

$\Rightarrow T = 1/25$ s

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

Solution

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



Example 3

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

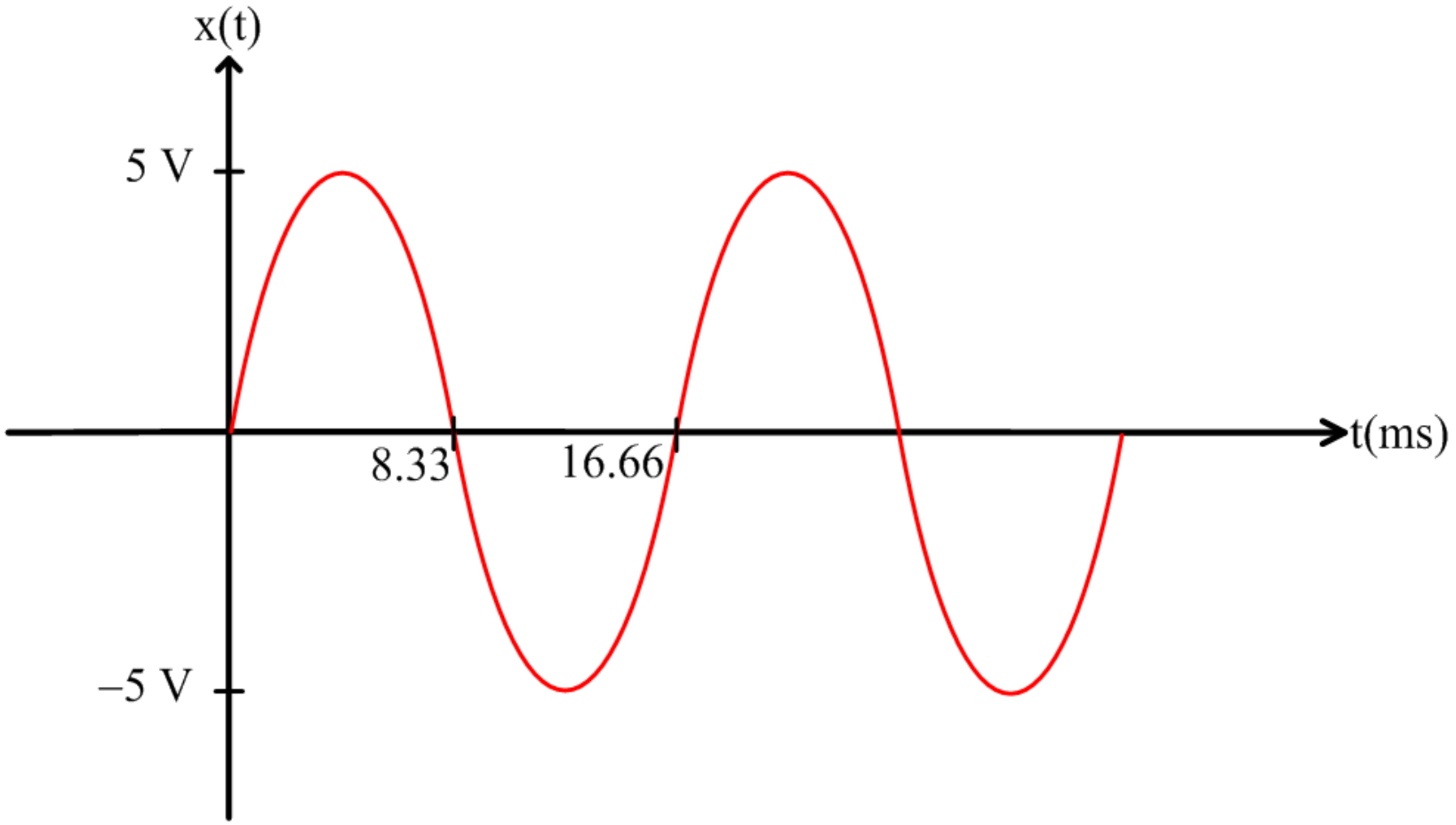
Sol:

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

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

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

Solution



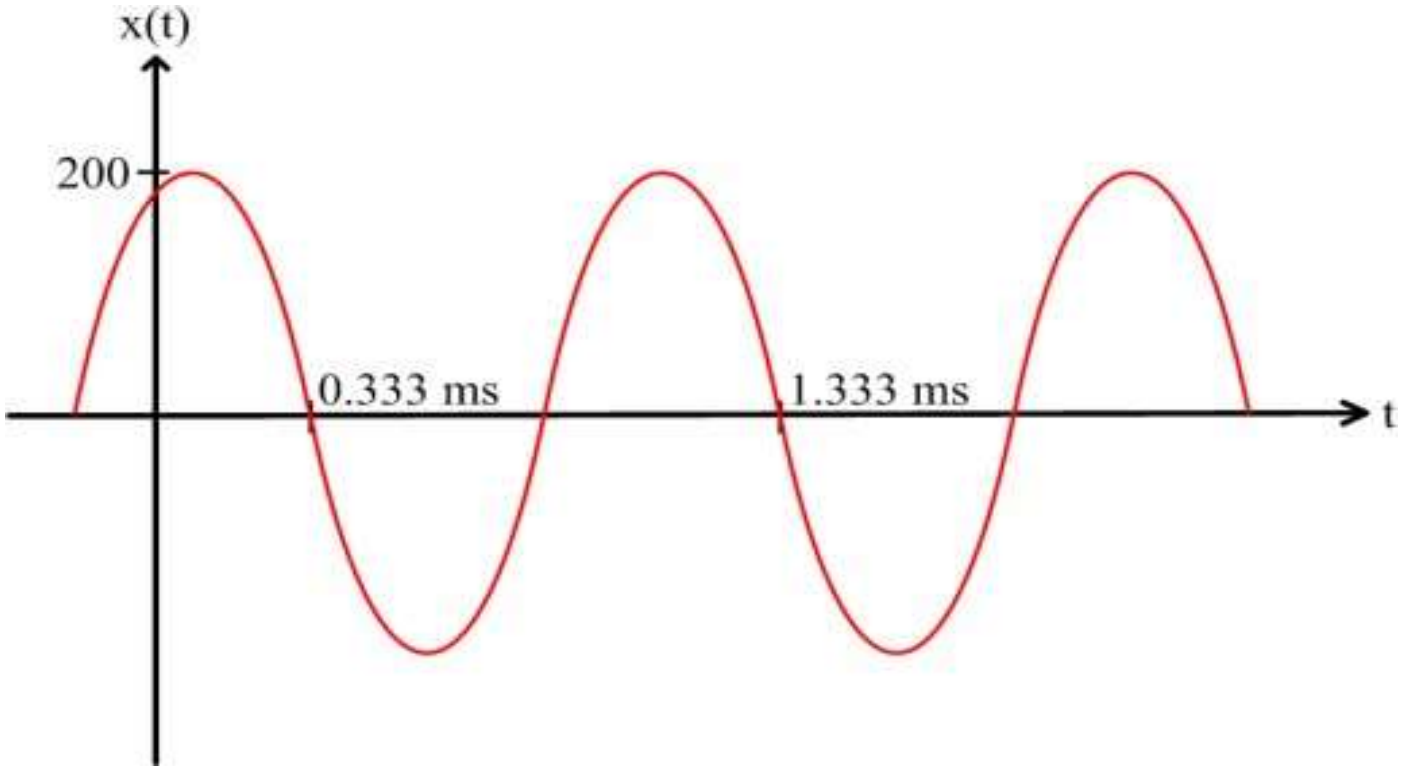
Example

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

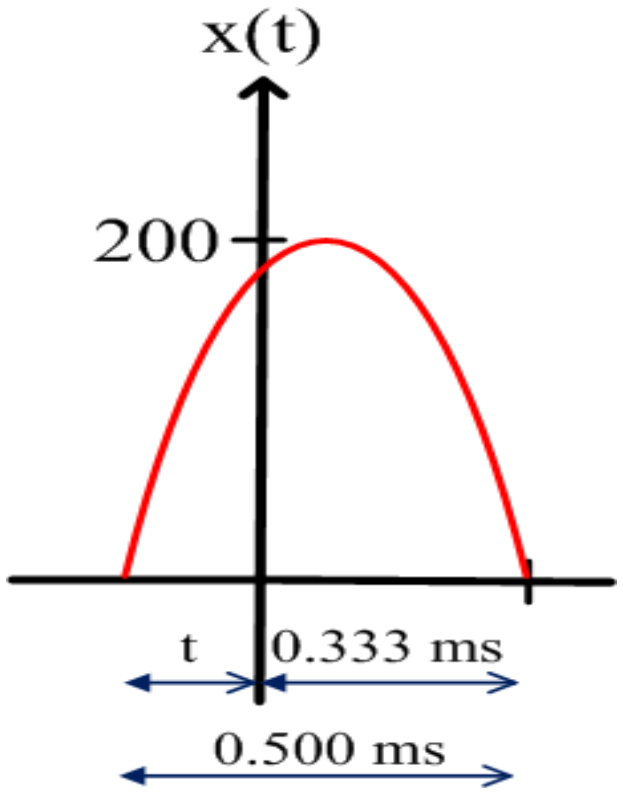
Peak (maximum) value, $A_{(p)} = 200$.

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

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



Solution



$t = 0.500\ ms - 0.333\ ms$

$= 0.167\ ms$

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

$= 60.12^0$

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