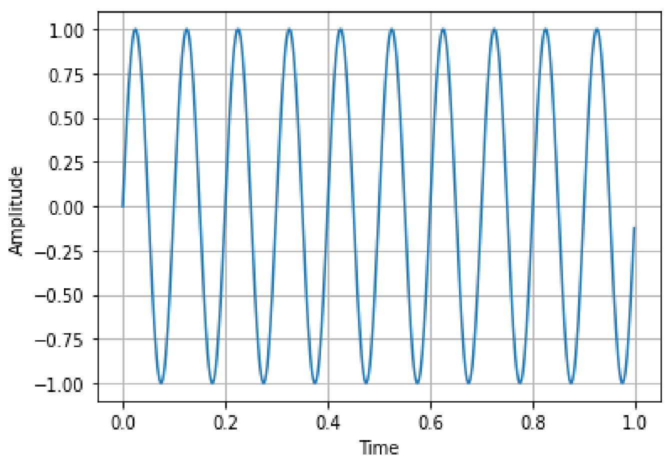
1. The function mysinplot takes in three arguments namely n,f,and fs as input where n is the number of cycles, f is the frequency, and fs is the sampling frequency. The function plots n cycles of the sine function with frequency f sampled at fs Hz. The x-axis of the plot is time which ranges from 0 to n*(1/f) sampled at a rate of 1/fs. The y-axis of the plot shows the amplitude of the sine function. Equation of the sine function is:

$$y = sin(2\pi f x)$$

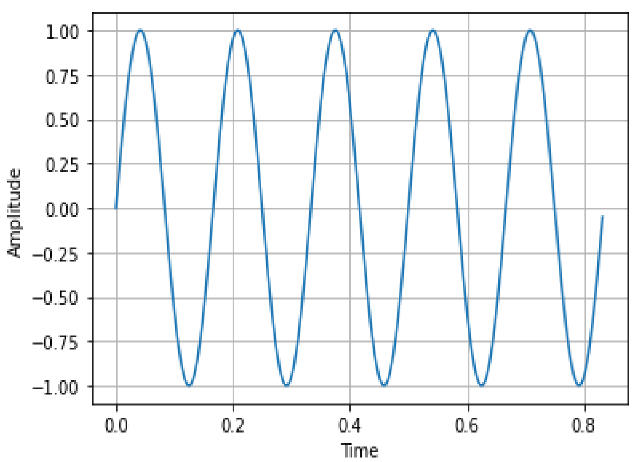
(a) fs=500 f=10 n=10

```
mysinplot(10,500,10)
```



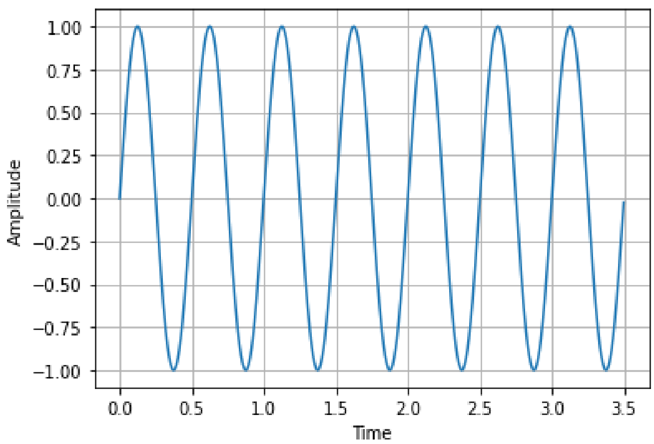
(b) fs=500 f=6 n=5

```
mysinplot(6,500,5)
```



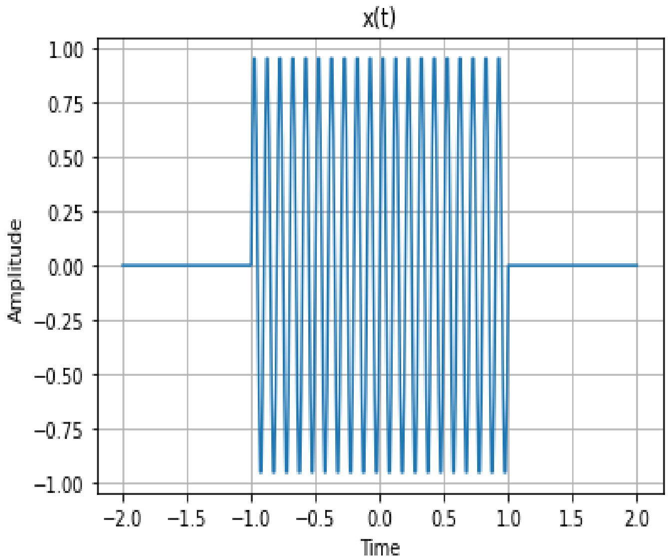
(c) fs=500 f=2 n=7

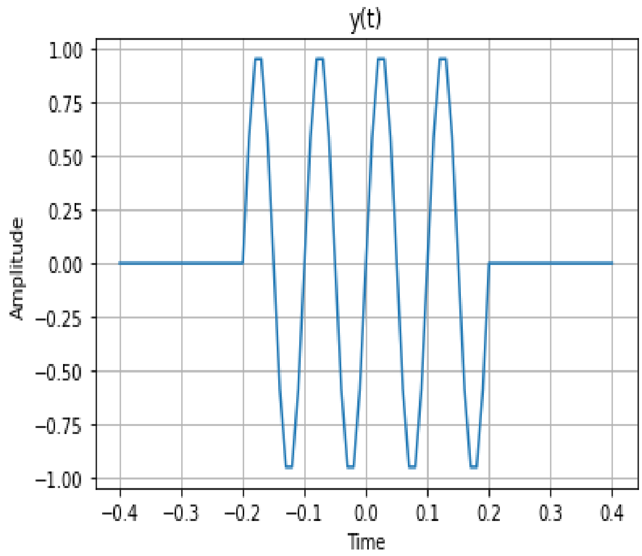
```
mysinplot(2,500,7)
```

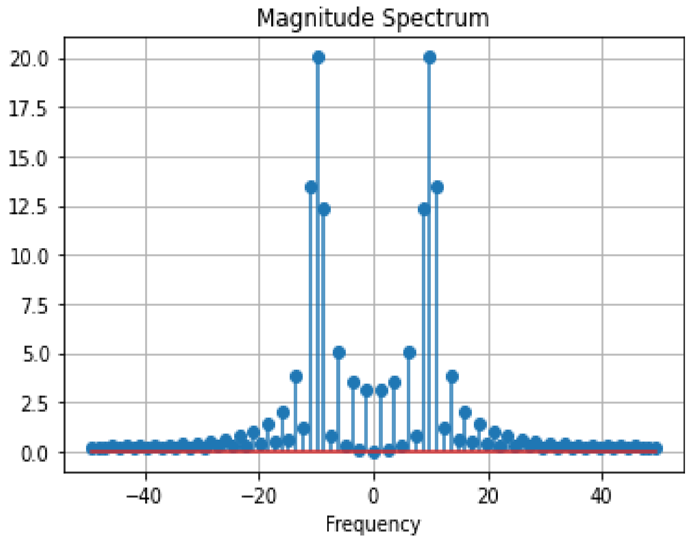


2. To make the bounded sine function, We first create a helper function create_rect to check if t is greater than T or less than -T and consequently returns 1 or 0 which is used in our create_bounded_sin_func to construct the bounded sin function from a normal sin function which is created in the range -2T to 2T. The helper function makes sure that any values lying outside [-T,T] become 0 to signify our bounded sin function. In the myctft function, x(t) and yd(t) are created using the bounded sin function. We check to see if T1 < T and choose the minimum of both. Later on we take the fourier transform of yd(t) and the x axis is scaled using fft and fftfreq function provided in the numpy library. Lastly Matplotlib is used to plot x(t), yd(t) and magnitude spectrum of yd(t).

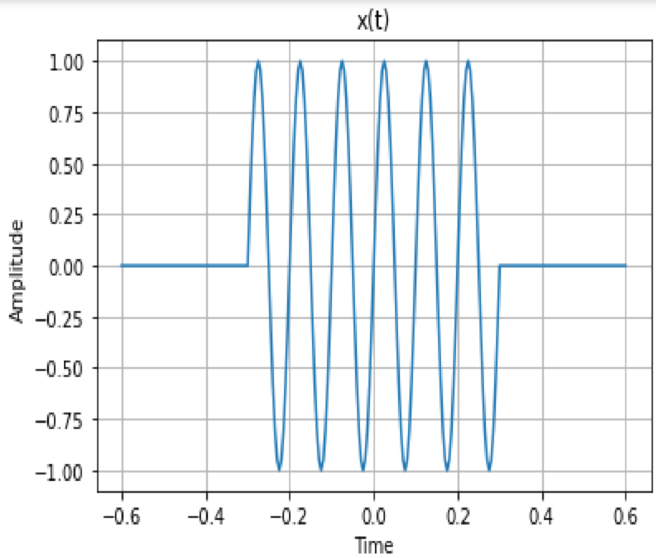
   (a)
   T=1s T1=0.2s Fs=100

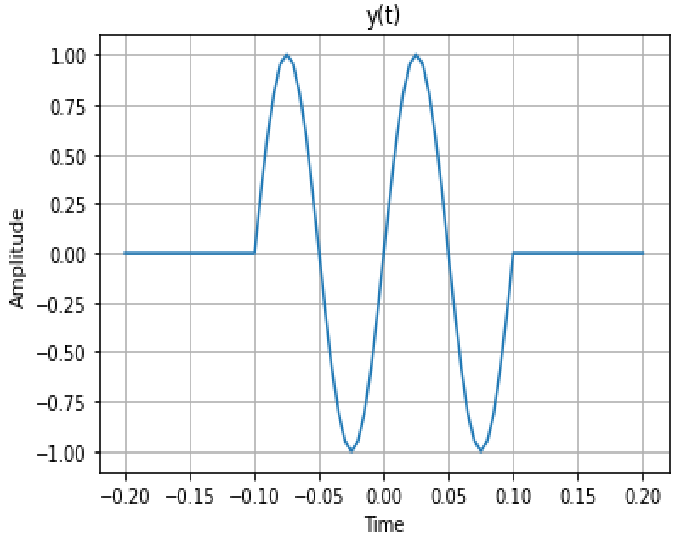


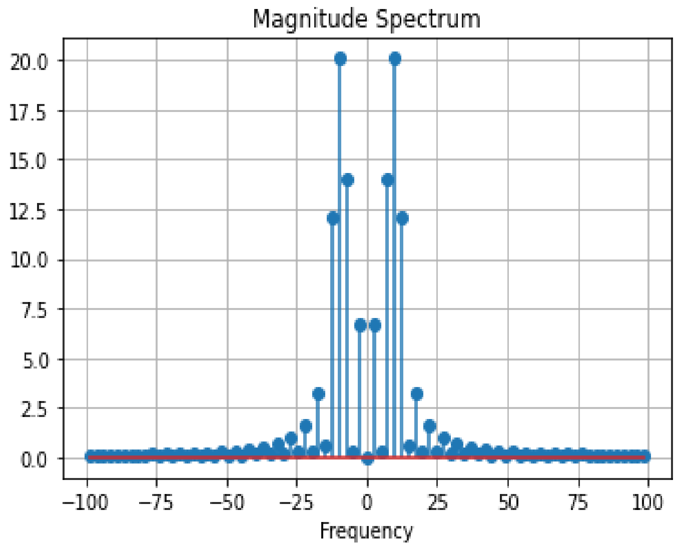




T=0.3s T1=0.1s Fs=200







(b) f=10Hz

Analytical

$$x(t) = \sin(2\pi f t) \times \Pi\left(t/T\right)$$

$$\therefore \mathcal{F}(x(t)) = \mathcal{F}\left(\sin(2\pi f t) \times \Pi\left(t/T\right)\right)$$

$$= \mathcal{F}\left(\sin(2\pi f t)\right) * \mathcal{F}\left(\Pi\left(t/T\right)\right)$$

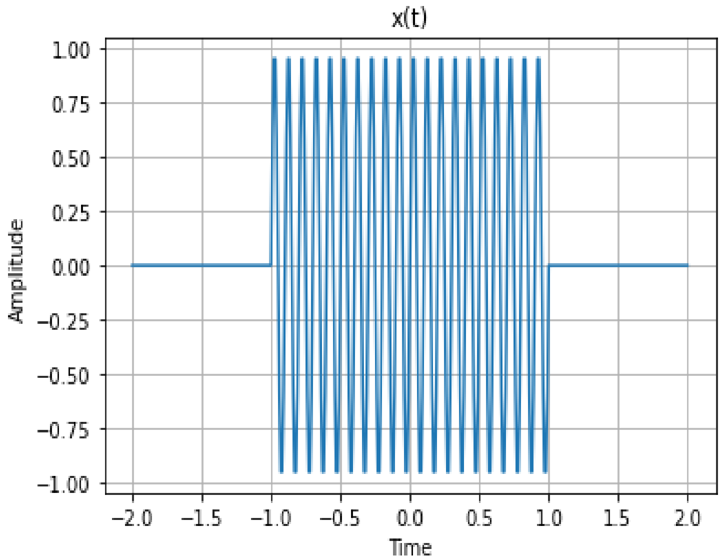
$$= \frac{\pi}{j}\left(\delta(\omega-\omega_0) - \delta(\omega+\omega_0)\right) * T\,\mathrm{sinc}\left(\omega T/2\right)$$

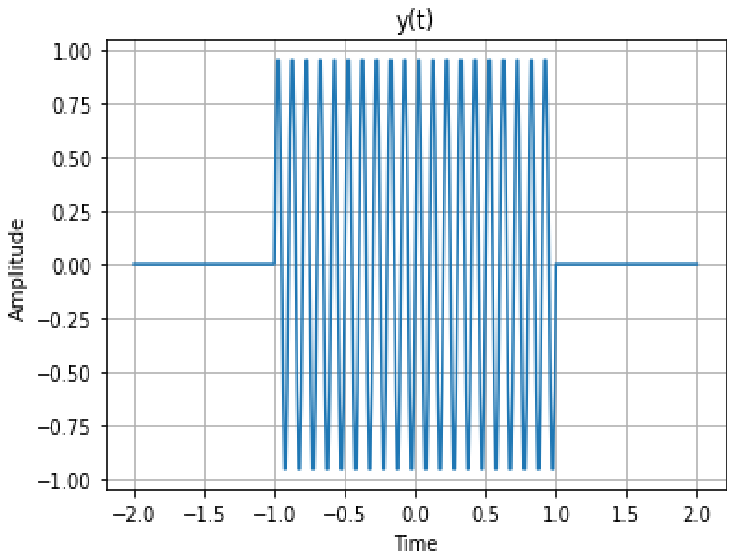
$$= \frac{\pi T}{j}\left(\mathrm{sinc}\left[(\omega-\omega_0)T/2\right] - \mathrm{sinc}\left[(\omega+\omega_0)T/2\right]\right)$$

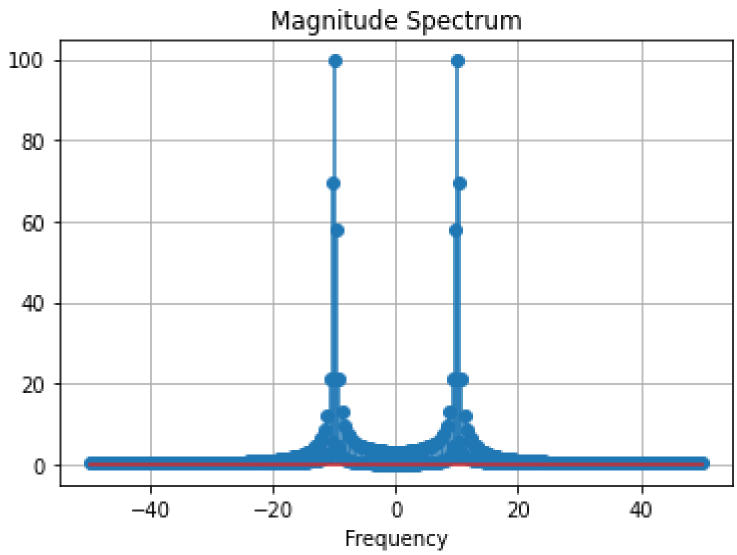
$$\therefore \mathcal{F}(x(t)) = -j\pi T\left(\mathrm{sinc}\left[(\omega-\omega_0)T/2\right] - \mathrm{sinc}\left[(\omega+\omega_0)T/2\right]\right)$$

$$\omega_0 = 2\pi f = 20\pi, \quad T = 1 \text{ sec}$$

(c)
T=T1


x(t)
Amplitude
Time


y(t)
Amplitude
Time


Magnitude Spectrum
Frequency

When T=T1, we're considering the entire truncated sine wave and not an interval of it so in that case the Fourier transform of the sine wave is much more sharper in comparision to the ones when T<T1.