Lab 3

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1 Exercises

1.1 Exercise 1

Solved with the following two code blocks:
x(t):

```
function x = x(t)
    x = (3/2+3/10*sin(2*pi*t)+sin((2*pi)/3*t)-sin((2*pi)/10*t)).*sinc(t);
```

Plot:

```
function Ex1 = Ex1()
    t = -5:0.1:5;
    plot(t,x(t));
    xlabel('t');
    ylabel('x(t)');
```

See figure 1 for the result.

1.2 Exercise 2

From the given expression of $x(t)$ we see that the upper angular frequency is $f_{max} = 2*pi$ and the lower frequency is $f_{min} = 2*pi/10$ the bandwidth of $x(t)$ is $f_1 = f_{max} - f_{min} = 2*pi - 2*pi/10 = 9/10 = 0.9$
The sampling theorem states that the sample rate $f_s = 1/T_s$ must be a minimum of $2f_{max}$. Since the maximum frequency is $f_{max} = 2*pi$ the frequency of sampling must be 1.8π. Where $T_s = 1/2$.

1.3 Exercise 3

With the interval $T_s = 1/2$ an almost identical graphical representation of the original signal is shown, see figure 2.

1.4 Exercise 4

The sampling theorem specifies a minimum-sampling rate where a properly sampled signal can be reconstructed from the samples. The rate $T_s = 1/2$ that we solved in Exercise 2 will then be enough to reconstruct the signal.

1.5 Exercise 5

The command *hold* in Matlab helps with drawing these figures you are about to see. By allowing us to draw over a already present plot helps us showcase continuous-time signals by using two instances to plot multiple functions. We plot equation a, b, c, d in figure 3,4,5,6, respectively. We progressivly see a closer representation of $x(t)$ (Orange in figures 3 - 6) from exercise 1.For equation d in figure 6 we use the value $r = 1000$ which gives an almost exact representation of $x(t)$.

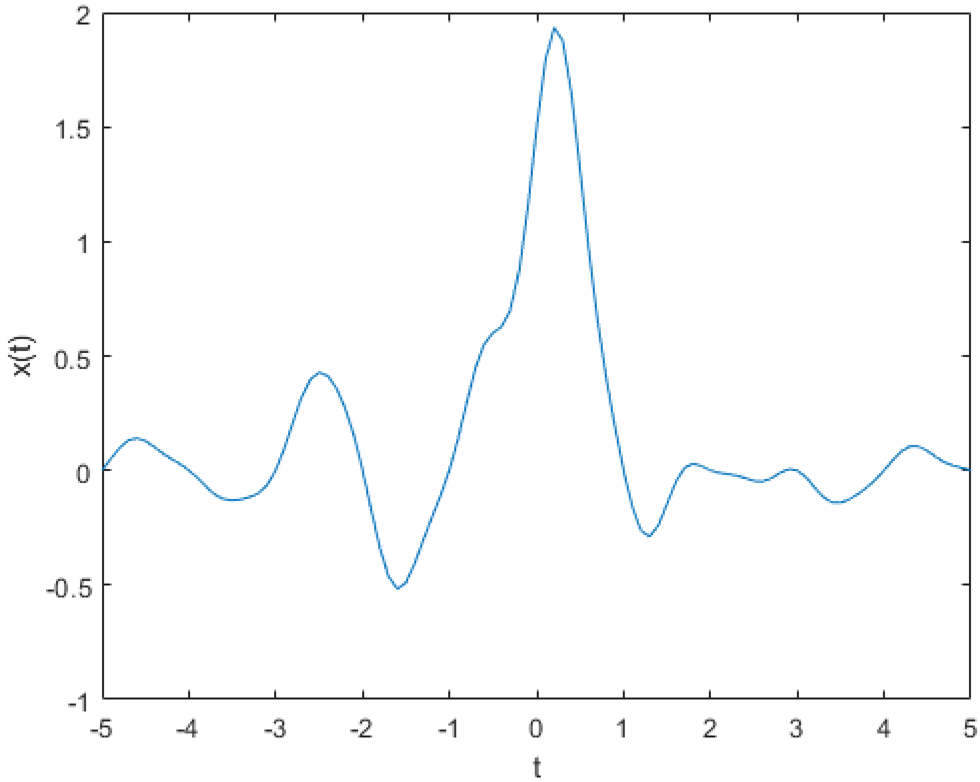

Figure 1: Exercise 1

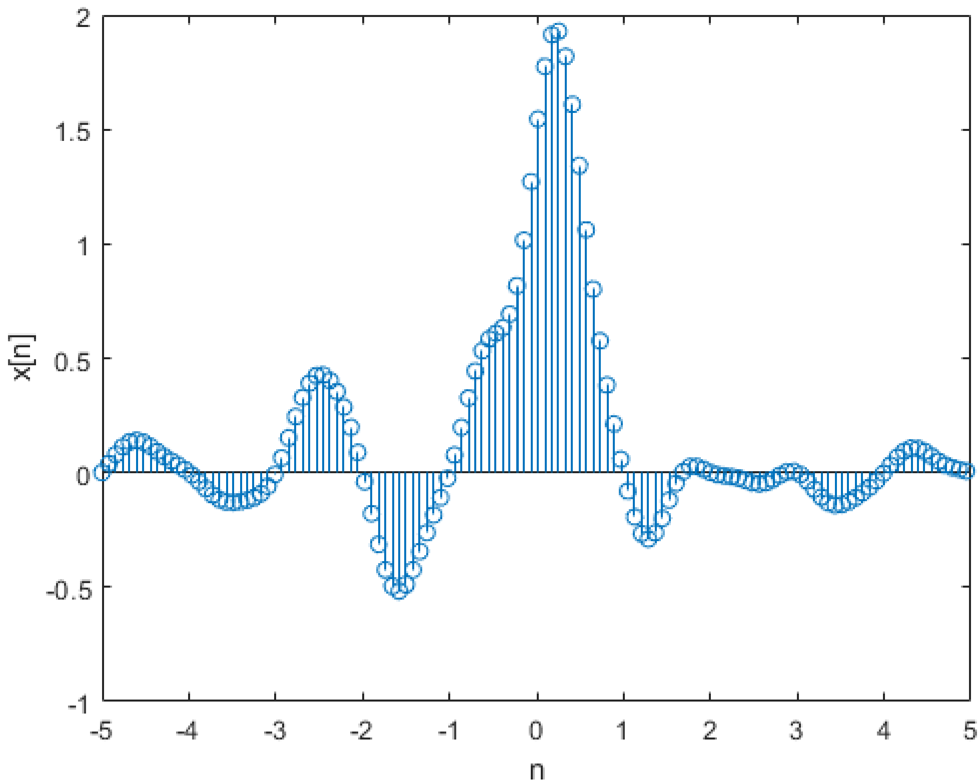

Figure 2: Exercise 3

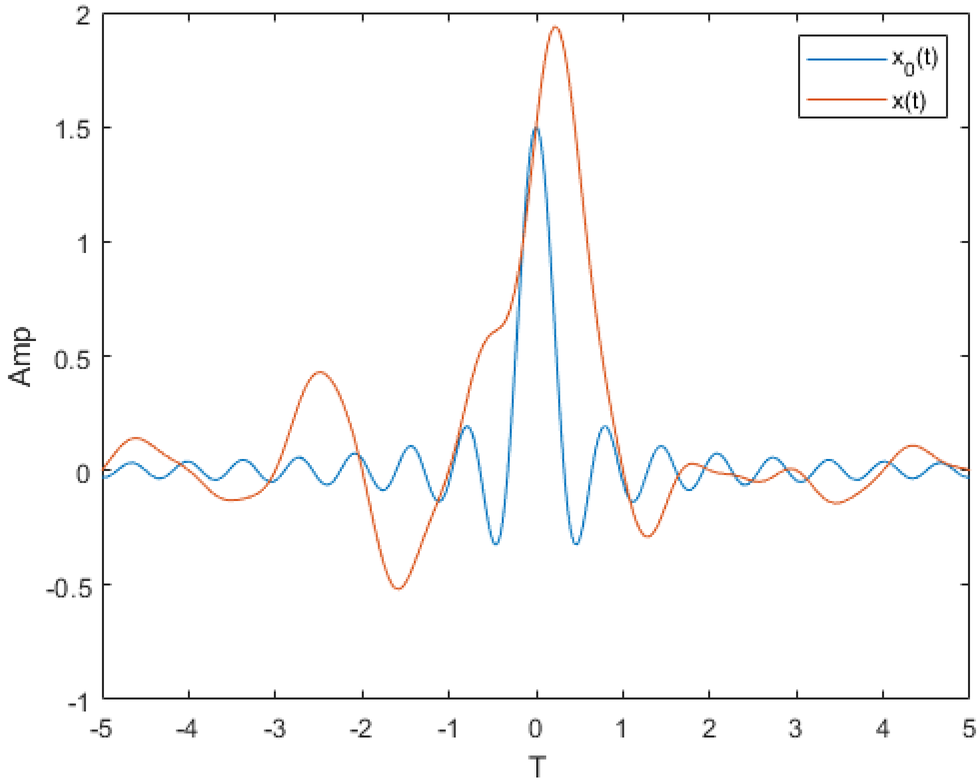

Figure 3: Exercise 5: a

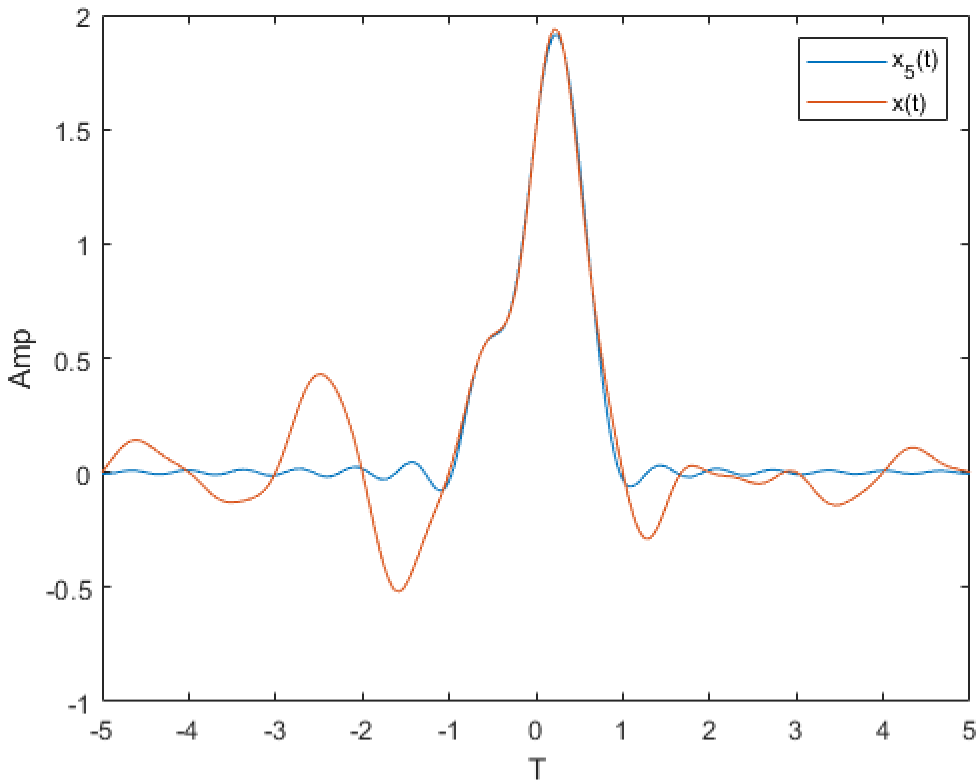

Figure 4: Exercise 5: b

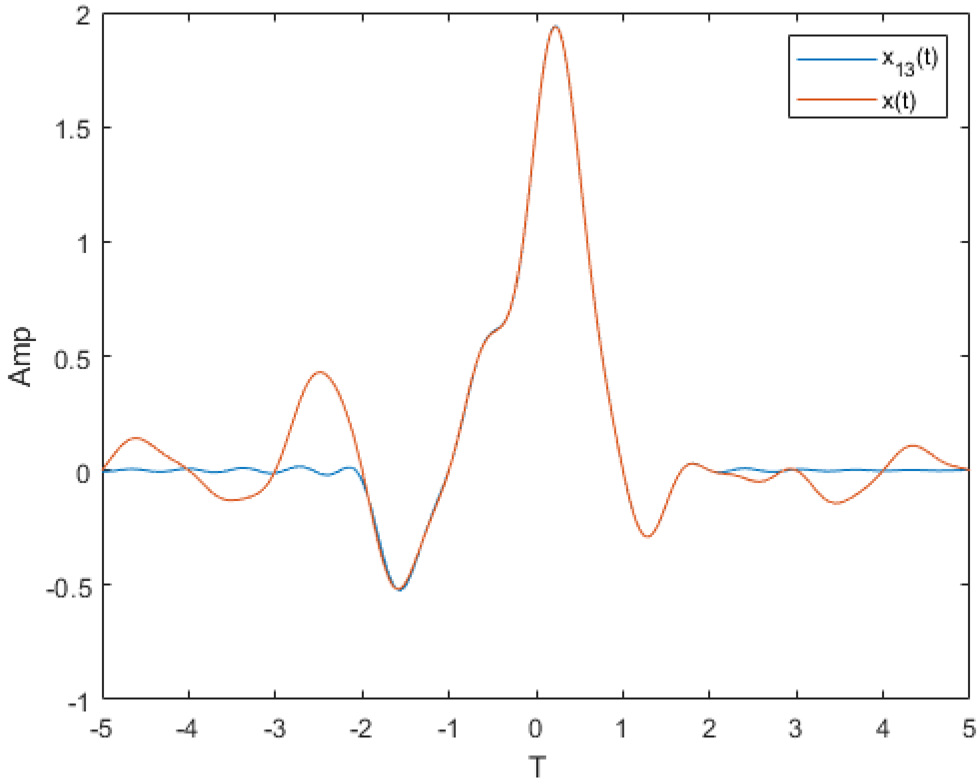

Figure 5: Exercise 5: c

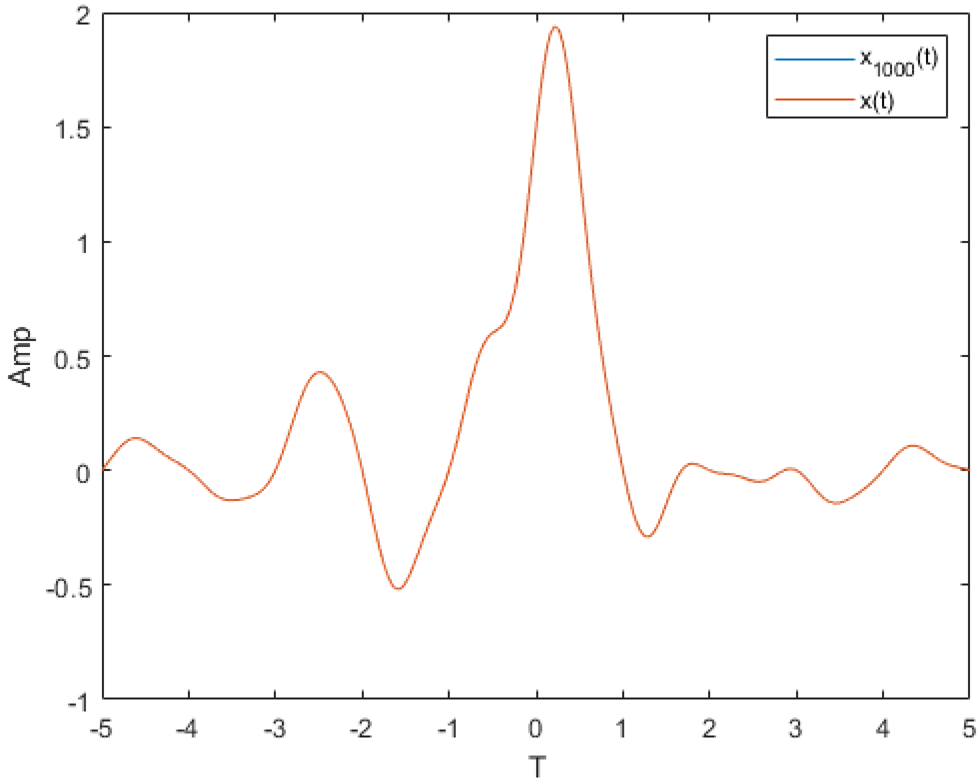

Figure 6: Exercise 5: d