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);
```

And for the 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 then$f_1 = f_{max} - f_{min} = 2 * pi - 2 * pi/10 = \frac{\pi 9}{5} = 1.8\pi$ which gives us a bandwidth of 1.8π.
The sampling theorem states that the sample rate must be atleast two times larger then our max frequency 2π, hence sampling rate must be atleast 4π. And since $T_s = \frac{1}{f_s}$ means $T_s <= \frac{1}{4}$. Summary: The frequency of sampling must be $T_s = \frac{1}{4}$. And the bandwidth 1.8π.

1.3 Exercise 3

With the interval $T_s = \frac{1}{4}$ 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 $T_s = \frac{1}{4}$ 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 $x(t)$.

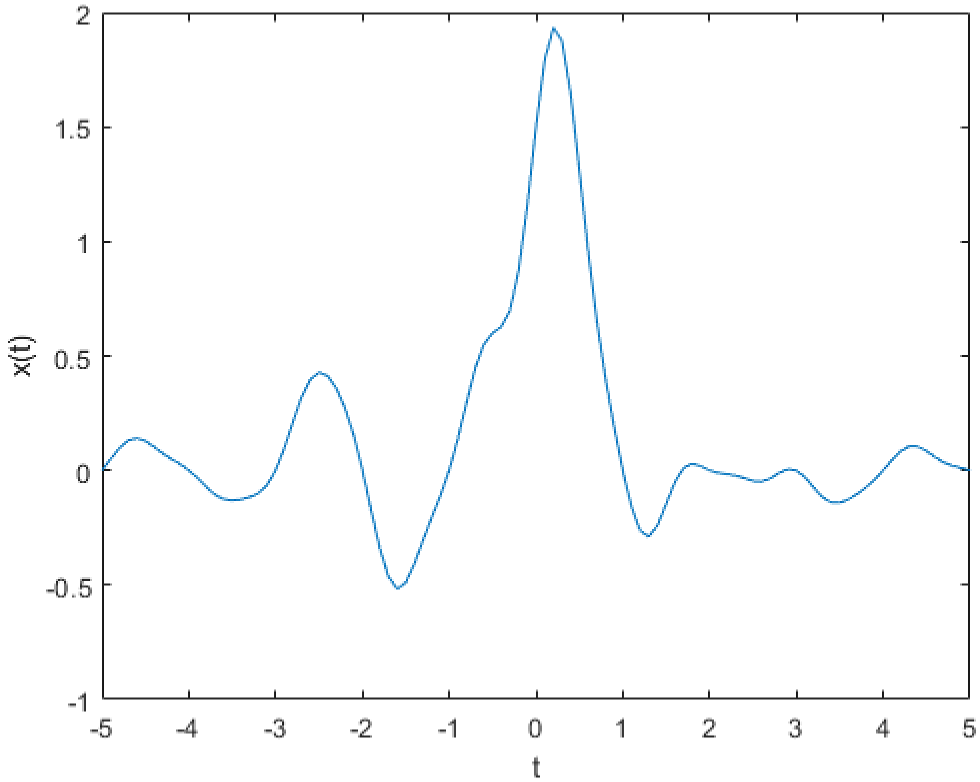

Figure 1: Exercise 1

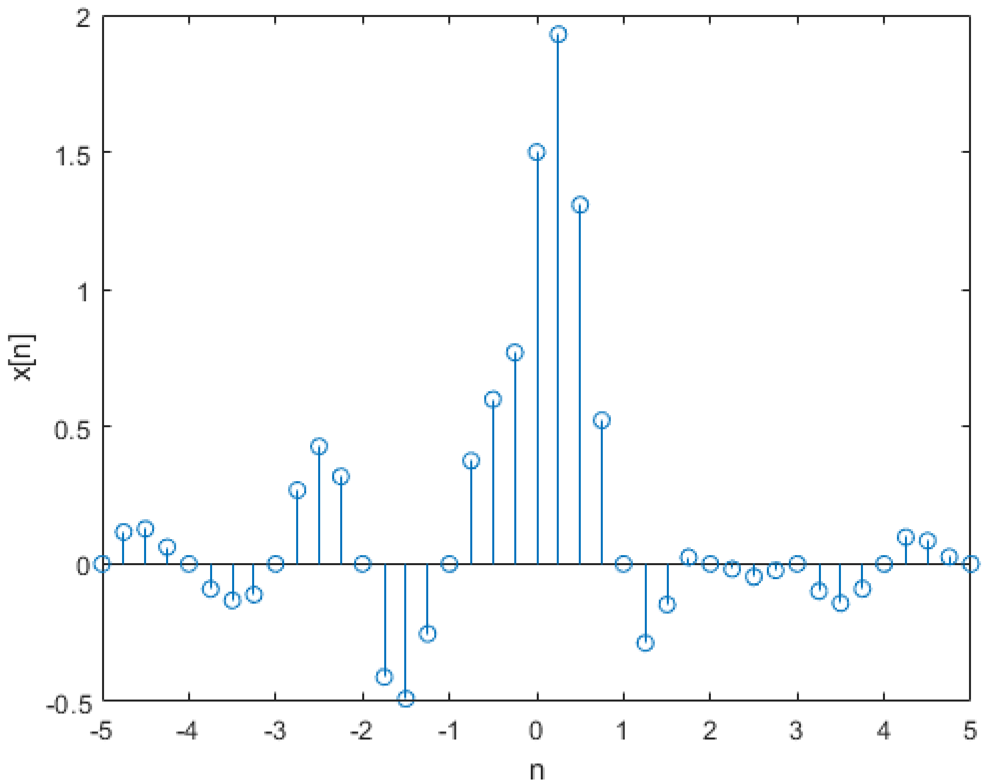

Figure 2: Exercise 3

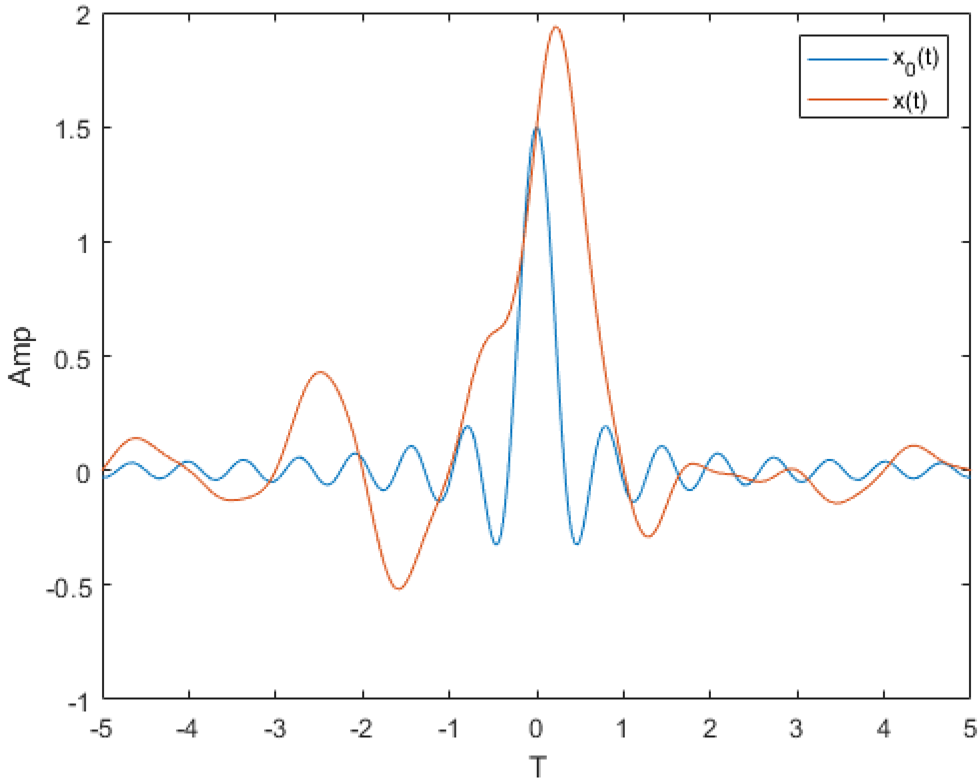

Figure 3: Exercise 5: a

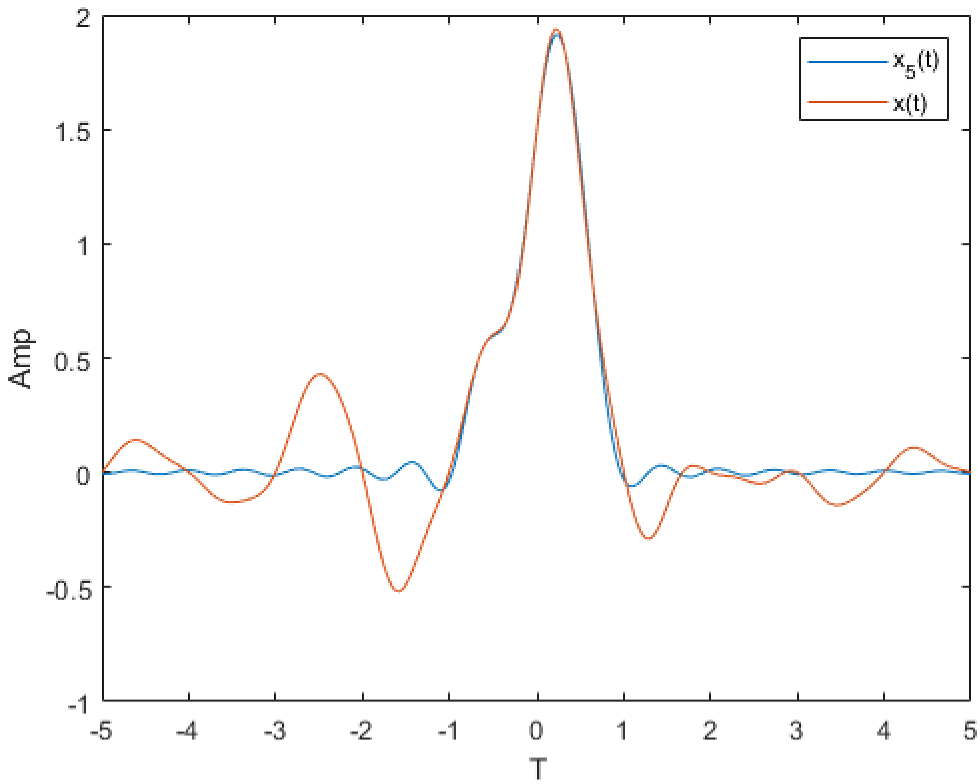

Figure 4: Exercise 5: b

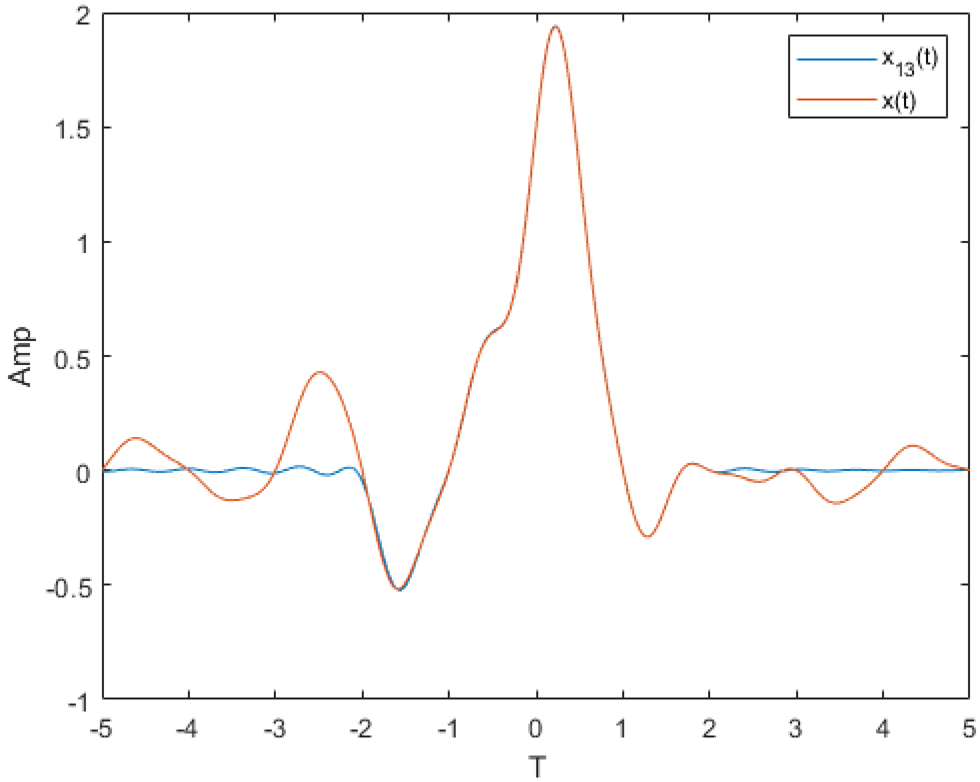

Figure 5: Exercise 5: c

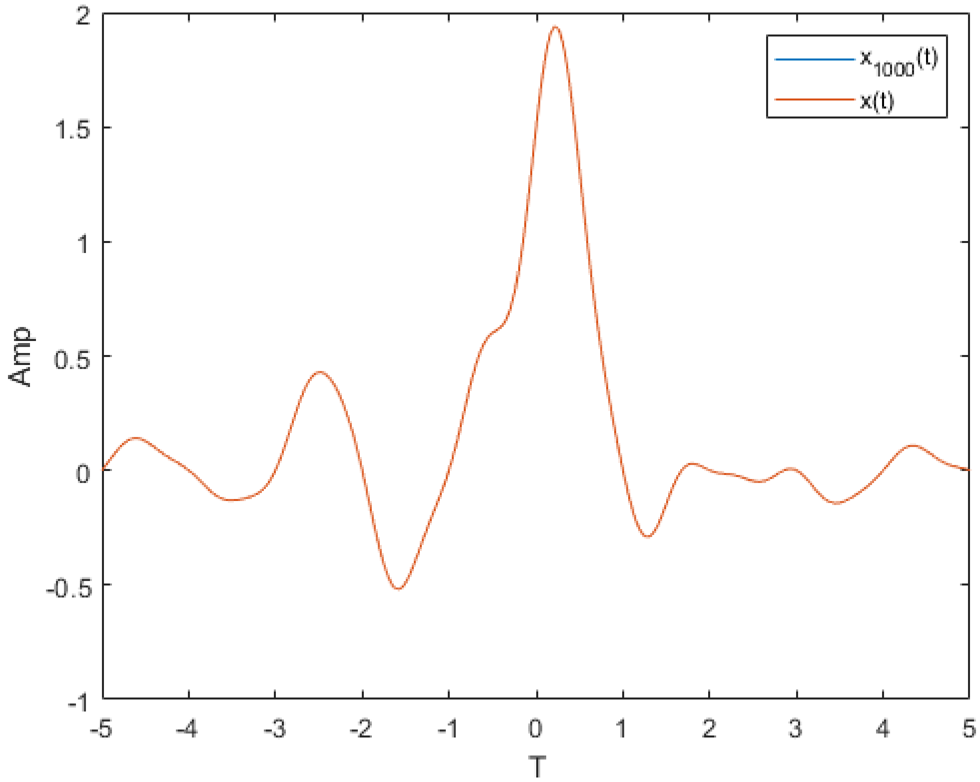

Figure 6: Exercise 5: d