Work 1
FREQUENCY ANALYSIS OF SIGNALS USING MATLAB

B) Frequency analysis 1

At first we generate the signal formed in preliminary questions' part 3b in Matlab's editor and make a Fourier-transform to it.

- Open Matlab's editor. You may use the macro created in part A, or create a new listing (New).

- Set variable Fs (sample frequency) in the beginning of the listing and give it value 8192.

```
Fs = 8192;
```

- Write time vector's beginning, stepping and end values under the first line.

```
t = (0:1/Fs:1-1/Fs);
```

- Write formula for signal x formed in preliminary questions under the previous line. If you don't have a copy of your answers, ask the assistant to loan your answers to you! If your formula isn't correct, assistant will give you the correct formula to use!

- Right afterwards make a FFT-transform to the signal:

```
N = max(size(x);
X = abs(fft(x))*2/N;
```

- Set frequency vector under the line above:

```
F = (0:1:Fs-1);
```

- Signal's presentation in time and frequency domains can be plotted one under the other in the following way (you don't have to write comment rows that begin with %).

```
%Defining number of vertical graps to be 2,horizontal 1,
%and place the next graph to be the first one;
subplot(2,1,1);
%Printing the signal in time domain;
plot(t,x);
grid on;
zoom on;
%Placing the next graph under the first one
subplot(2,1,2);
%Printing FFT-transform of the signal;
plot(F,X);
grid on;
zoom on;
shg;
```

- Save the file by name signal1 to a directory named by assistant. Run the file in Matlab and make possible corrections in the listing.

● If you think the graph is correct, make needed adjustments to make the graph fill the whole page and print the graphs.

● Change the lower plot-command plot(F,X) to form

```
semilogy(F,X);
```

This changes the vertical scale logarithmic,and frequency scale remains linear.

● Write under the upper grid on –command

```
axis([0 0.05 –5 5]);
```

Now the time scale begins from zero and ends to 50 milliseconds. Vertical scale begins from –5 and ends to +5.

● Correspondingly, write under the lower grid on –command

```
axis([10 Fs/2 1e-3 5]);
```

Now frequency scale begins from 10 and ends to Fs/2, 4096 Hz. Lowest value on amplitude scale is 1 mV and highest 5 V.

● Write the name labels to scales under the upper axis-command

```
xlabel('Time/s');
ylabel('Voltage/V');
```

and under the lower axis-command

```
xlabel('Frequency/Hz');
ylabel('Amplitude/V');
```

● Write under the first axis-command the title for the whole presentation with command

```
title({'Sum of cosine waves, dd.mm.2002','x and y','Assistant z'});
```

, where dd stands for day, mm for month, x is your, y your pair and z assistant's name. Notice '-marks in the commands.

● Save the altered listing by the same name and run the listing in Matlab. Don't print your achievement yet!

● Change the vertical and horizontal scales in both prints so that results are clearly interpretable. Save listing and run it in Matlab.

Now let's listen the signal.
● Make sure, that loudspeakers are on!

Peak value of the signal for sound card may be at most one.

● Add the following row in the end of the listing to make scaling aright

```
soundsc(x,Fs); %Plays signal x with sample frequency Fs.
```

● Save listing and run it in Matlab. Now you should hear the sum wave from the loudspeakers for one second. Print both one program listing and one graph to your group. Make sure that the graphs fill the whole A4 sheet! Remember that you can make notes in the graphs for the report!

● Don't close the editor, while you can take advantage of your listing in the following parts of the work!

@ Present the answers to following questions in the report:

@ Mark the period and frequency of the signal to your print.

@ Circle one impuls in frequency domain and mark to the picture, what the impuls means in time domain. You may also present the formula! Mark also presentation of an impuls in frequency domain (symbol and/or formula) to the picture. Hint: there might be use for δ-symbol.