4-th practical exercise
Optimal Receivers for Binary Shift Keying Signals

The purpose of the work is to create to perform reception of the signals modulated by BASK, BFSK and BPSK. This exercise adds receiver to programs already created during the 3-rd practical exercise.

The report should be prepared and sent to email address: elans.grabs@rtu.lv. The report must include the following:

1. The objective of practical exercise;
2. The full source code of simulation programs (3 programs);
3. The plots obtained during simulation (for each modulation, with and without noise).

The tasks to be solved:

1. Add optimal correlation receiver to each of the 3 previously created programs (in 3-rd practical exercise).
2. In each plot (as subplot of 2 or 3 figures), You must show:
    a. Received noisy signal;
    b. Integrator (or 2 integrators) signal.
3. Perform detection and output the received data in command line. Compare result with originally selected data vector sB.
4. Analyze influence of noise power (SNR ratio) on accuracy of detection.

The guidelines for practical exercise

1. After noise introduction, at the end of the program You need to add FOR loop, where each received symbol will be processed separately. Here, N is the number of binary data symbols.

```
for k = 1:N


end
```

The further work (except plotting and output) will be performed inside this loop.

2. In this loop, we need to correctly read symbols form received signal waveform vector. The indices must be calculated for each symbol based on loop variable *k* (see above).

```
idx = (1:200) + (k-1)*200;
```

3. The, considering the modulated and noisy signal is named sBASK and carrier signal is named s0, the multiplication of signals can be performed element-wise, by using .* operator:

```
sM = s0.*sBASK(idx);
```

4. After multiplication, the continuous integral must be calculated. In simulation software, we will calculate finite sum instead, but we need a function to see how sum is accumulating, rather than only last result. For this purpose we can use cumsum( ) function, which calculates sum cumulatively for each symbol. Afterwards, we append this result to integration signal:

```
sI1 = [sI1, cumsum(sR)];
```

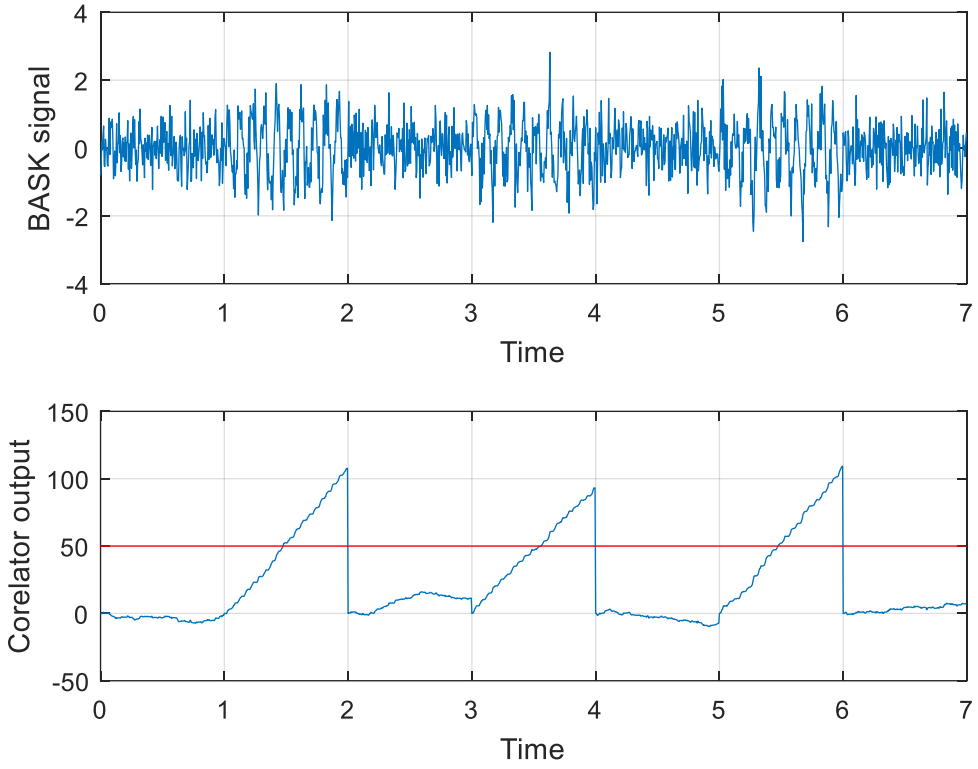
5. Use subplot(211) and subplot(212) to draw plots for modulated signal sBASK and integrator output signal sI1.

6. On the second subplot, You must draw threshold value (if there is any). For BASK case, the threshold is $E/2$, where E is the carrier signal energy (calculated before for noise power estimation).

7. Don't forget, You can draw multiple plots simultaneously in a plot( ) command:

```
plot(x1, y1, x2, y2, 'r');
```

As a result, plots similar to what is shown below must be obtained:



8. Use *if* function to perform comparison with threshold and set received symbol values.

9. Obtain results in a similar way for BFSK and BPSK modulation types. Note, that in case of BFSK You must calculated 2 integrator signals!