Ain Shams University
Faculty of Engineering
Electronics and Communication Department
ECE 252 Fundamental of Communication Systems
Spring 2025

Course Project

Analog communication

For the signal shown in the Figure 1:

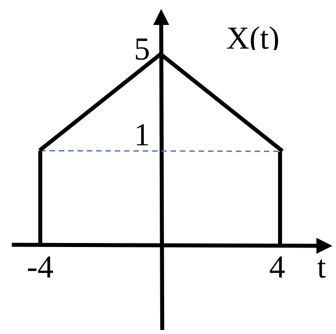

Figure (1)

1. Plot the function x(t) on Octave.

2. Derive an analytical expression for its Fourier transform.

3. Use Octave to calculate the Fourier transform of the signal with sampling frequency fs =100 Hz and resolution equal to 0.01 Hz, and then plot it together with the analytical expression on one graph.

4. Estimate the BW defined as the frequency band after which the power spectrum of the signal drops to 5% of its maximum value.

5. If this signal is to pass through a perfect LPF with BW= 1Hz. Plot the output of the filter in the time domain along with the input signal.

6. Repeat (5) if the LPF BW is reduced to be = 0.3 Hz.

7. For m(t) defined as below, Repeat steps 1-4.

$$m(t) = \left\{ \begin{array}{cc} \cos(2\,\pi * 0.5 * t) & 0 < t < 4 \\ 0 & otherwise \end{array} \right\}$$

8. <u>FDM Modulation Scheme:</u>

It is required to transmit x(t) and m(t) on different channels. Where x(t) is modulated in DSB-SC, and m(t) is modulated by SSB. Each channel bandwidth is 2 Hz.

- The modulated signal is $s_1(t)$: x(t) is to modulate a carrier signal $c_1(t) = \cos(\omega_c t)$ with carrier frequency $f_c = 20Hz$, Use x(t) from step 5.
- The modulated signal is $s_2(t)$: m(t) is to modulate a carrier signal $c_2(t)$, such that there is only 2 Hz guard (empty) band between the two channels.

9. State whether you will use USB or LSB.

10. Write an appropriate value for $c_2(t)$

11. Plot s(t) which is $s_1(t) + s_2(t)$ then Plot S(f).

12. Create a coherent demodulator for each channel and plot the received messages and the input messages on the same figure.

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Digital communication

Part I

Using Octave simulator, you have to develop a code for line coding. Each group will choose two types of line codes and make a comparison between them. Each group should select one of these line codes: AMI, CMI, and Manchester to be compared with one of these codes: unipolar non-return to zero, and polar non-return to zero. Each group must plot the time and spectral domains of the pulses. The students should select the number of bits to be at least 64. This bit stream should be selected to be random, which means that the type of each bit is randomly selected by the program code to be either ‘1’ or ‘0’.

The report must have the program code. The report must include explanations of the temporal and spectral plots of the two-line codes and the advantages of one on the other.

Part II

Each group develops a program code for the transmitter and coherent receiver of either of ASK, FSK and PSK systems. The baseband data can be the random data explained above. The carrier frequency should be selected to be higher than the bit rate. The student must plot the temporal and spectrum of the signal at outputs of the transmitter and the receiver. In the receiver, each group should select the oscillator phase to be 30°, 60°, and 90°, and comment of the results each group will get.

Each group must at least do one of these parts. Performing both of them will be considered as a bonus.

Helpful functions:

- clear, close, clc.
- zeros(), length(), linspace(),nextpow2()
- fft(), fftshift(), ifft(),ifftshift(),conv()
- figure,plot(),subplot(), hold on, grid, title(), xlabel(), ylabel(), legend(), axis().

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