I. INTRODUCTION

In this assignment you will be dealing with the spectral characteristics of signals.

II. EXPERIMENTS

E1. Fourier series

The purpose of this problem is to evaluate and plot the Fourier-series coefficients of a periodic signal. The periodic signal $x(t)$, with period $T_0$, is defined as

$$x(t) = A \Pi \left( \frac{t}{2t_0} \right) = \begin{cases} A, & |t| \leq t_0; \\ 0, & \text{otherwise} \end{cases}$$

for $|t| \leq \frac{T_0}{2}$, where $t_0 < \frac{T_0}{2}$. Let $A = 1$, $T_0 = 4$ and $t_0 = 1$.

1) Demonstrate mathematically that the Fourier series coefficients in the expansion of $x(t)$ are given as

$$x_n = \frac{1}{2} \sin \left( \frac{n\pi}{2} \right) = \frac{\sin(n\pi/2)}{n\pi}.$$

2) Use Matlab to plot the original signal $x(t)$ and the fourier series approximation of $x(t)$ over one period for $n = 1, 3, 5, 7$ and $9$. Note that as $n$ increases, the approximation becomes closer to the original signal $x(t)$.

3) Plot the discrete magnitude spectrum $|x_n|$ and phase spectrum $\angle x_n$ for $|n| \leq 20$.

Simulink is yet another interesting tool of Matlab. In the Simulink library there are various input, output and system blocks which can be used as basic building blocks to model a more complicated input-output system. In this assignment you shall first learn to create simple simulink files and then finally you shall be implementing a simple bandpass communication system.

E2. Introduction to simulink

1) Create a simple simulink model with a sinusoidal input as a source and scope as a sink block. Generate a 100, 500 and 1K Hz sinusoid and see it in the scope. Change the simulation time in the simulation - configuration parameters window to see 10 cycles of the signal for each frequency.

2) Replace the source in the previous experiment by a signal generator and repeat the experiment with sawtooth and rectangular inputs.

E3. Observe the spectrum of your voice signal:

1) Write a script to read the "output102.wav" file you created in your last experiment containing your voice of duration 3 seconds into a vector $V$. Use the in-built Matlab function spectrum to find the spectrum of the signal stored in $V$. Plot the spectrum and verify that the frequency components upto $7 - 8$ KHz has only significant power.

III. GENERAL GUIDELINES FOR THE LAB REPORT

Submit your lab report in an MS word document with a concise description of how you conducted each lab experiment, what are your results and include figures and plots which are necessary to support/justify your results. At the end of your report, you are also required to point out three things that you learned in this lab.

You should print the last page of this document, bring it in the lab and take the initial of your TA after finishing every step.
Report for lab assignment 2 (Communications -I, NDSU-ECE-443/643)

Name of student: ____________________________  Date of experiment: ____________________________

Student ID: ____________________________  Date of submission: ____________________________

Show your results to the TA and take his initial after finishing each assignment.

Experiment E.1:
1) ____________________________

2) ____________________________

3) ____________________________

Experiment E.2:
1) ____________________________

2) ____________________________

Experiment E.3:
1) ____________________________