ENGR 253 LAB #3 - MATLAB Design Flow and Power/Energy Calculation

Objective
Gain working knowledge of design flow and loops in solving signal and systems such as output signal and power/energy calculation.

Resources
- Signals & Systems textbook by Oppenheim and Willsky
- Windows running MatLab release 14 or later
- USB hard disk or other removable drives (note Lab computer data is lost after reboot)
- Course Lecture Material

Background
1) "**Clc**" command clears the command windows texts. "**Clea**r" command will clear all the workspace variables.

2) Matrix operation:

+	Add
-	Subtract
*****	Multiply
/	Divide
^	Power
.*	Term-by-term Multiply
./	Term-by-term divide
.^	Term-by-term power

3) **for** Loop
Repeat statements a specific number of times. The general form of a for statement is:

for variable = expression statement**,** ...**,** statement **end**

Example:
```
for I = 1:N,
   for J = 1:N,
      A(I,J) = 1/(I+J-1)
   end
end
```

Note: "," is used to separate statements that are being Placed on a single line. New line automatically indicates new statement.

4) **if** Statement
Conditionally execute statements. The general form of the **if** statement is:
```
if expression
   statements
elseif expression
  statements
else
  statements
end
```

Example:
```
if I == J
  A(I,J) = 2;
elseif abs(I-J) == 1
  A(I,J) = -1;
else
  A(I,J) = 0;
```

```
end
```

5) subplot (m, n, p)
This command will create a m by n matrix of sub plots within the Figure window. p variable identifies the cell to be used by the next plotting command.

Below is a example that displays two plot in the Figure window:

```
subplot(2,1,1), stem(n,x);
xlabel('n');  ylabel('x[n]');

subplot(2,1,2), stem(n,h);
xlabel('n');  ylabel('h[n]');
```

Experiment #1

Write a function that accepts user input for upper and lower limits of n (Integer number). The coded function outputs the plot of the following function within the specified upper and lower limits of n:

$$Y[n]=\tan(3\pi n/11) + \sin(3\pi n/22)$$

Experiment #2

In the study of Signal and System, it is important to understand the system characteristics such as linearity, time invariance, stability, causality and invariability. In this experiment, write a function that uses inputs $x_1[n]=3\delta[n]$ and $x_2[n]=7\delta[n]$ to determine if the system output $Y[n]=\{\tan(3\pi n/11)\}^2 + \sin(6\pi n/21) + \cos(7\pi n/21)\{x[n] + 1\}$ represents the output of a linear system.

Experiment #3

Write a function that returns

- Average power (P_∞)
- Total energy in the interval $-10 \le n \le 210$

for the signal $x[n]=\sin(3\pi n/7) + \cos(5\pi n/21)$.

Report Requirements

Reports must be prepared individually even if the experiments are performed as a team. All reports must be computer printed (Formulas and Diagrams may be hand drawn) and at minimum include:

For each Experiment

a) A clear problem statement; specifying items given and to be found.
b) Theory or process used.
c) Resulting circuits, calculation, tables, timing diagram, schematic and other relevant results.

For the report as a whole

a) Cover sheet with your name, class, lab, completion date and team members' names.
b) Lessons Learned from the experiments.
c) A new experiment and expected results which provide additional opportunity to practice the concepts in this lab.