

Name: _____

Problem	Points	Score
1	25	
2	50	
3	25	
Total	100	

Notes:

- (1) Create a workspace in your home directory to work the exam. When you are done, copy your exam to the following directory:

`/data/courses/ece_1111/current/exams/ex_02/lastname_firstname`

Where “lastname” and “firstname” are your actual names. Set the permissions so only you have read and write permission to this directory. Create subdirectories within this directory for p01 and p02 similar to the first exam. Do not touch your files after the exam is over.

- (2) Your code must be nicely formatted and well commented, use Makefiles, etc. as we have done all semester. Failure to do these things will significantly lower your grade.
- (3) For this exam you are allowed to open a terminal window on your computer, you are allowed to web surf with Google, but you cannot use online chat or other interactive services.

(25 pts) Problem No. 1:

Use the program you created previously to generate a file containing 1 second of a sinewave with a frequency of 10 Hz sampled at 100 Hz with an amplitude of 10,000. Store the data as binary data using 16-bit integers. There should be 100 samples in this file, and the signal should go through 10 complete cycles. Verify this with the od command. Call this file mysinewave.dat.

Modify your sinewave program to generate a similar signal that has random values ranging from [-10,10]. Call this program p01.cc and create a file called mynoise.dat. This file should contain the same number of samples as your sinewave file – 100 samples. Use the same format as your sinewave file - 16-bit integers.

(50 pts) Problem No. 2:

Write a program to compute and print out the ‘energy’ of each file. Your interface should be:

```
p02.exe mysinewave.dat mynoise.dat
```

Your program should work for any two files. It should compute the energy by adding the squares of all the samples and dividing by the number of samples:

$$E = \frac{1}{N} \sum_{n=0}^{N-1} x[n]^2$$

Compute the energy of the signal in each file and print the value to stdout using a nicely formatted fprintf statement:

```
filename: <name1> Energy = <value>
filename: <name2> Energy = <value>
```

You must do this by writing a single function that takes a filename as input and returns the energy. Call this function twice in your main program – once for each file.

(25 pts) Problem No. 3:

Create a third program, p03.cc, that computes and prints the “signal to noise” ratio (the numbers below are just examples):

```
p03.exe mysinewave.dat mynoise.dat
signal energy = 100.0000
noise energy = 10.0000
signal to noise ratio (SNR) = 10.0000 dB
```

where you use the following equation to compute the SNR:

$$SNR|_{dB} = 10 \log_{10}(\text{signal energy}/\text{noise energy})$$

Does the value you get for your test cases make sense? (Hint: the energy of a sinewave is the amplitude squared divided by 2. The energy of the noise signal should be the range squared divided by 12.)