DUE DATE: THURSDAY, NOVEMBER 10, 2016

RETRIEVE THE DATA FILES FROM: http://dsplab.eng.fiu.edu/DSP/Courses/BSP1/

I. DATA FILES:

In this assignment you will be given six data files (or Matlab vectors), which were recorded from an awake adult subject under two different states, as referential recordings:

	STATE 1	STATE 2
Electrode Pz	S1Pz	S2Pz
Electrode Cz	S1Cz	S2Cz
Electrode Fz	S1Fz	S2Fz

Each file (vector) contains 500 samples. The sampling frequency used was 250 samples /second. Thus each record represents an interval of two seconds.

Show a plot of each signal, after the DC component has been removed from the record. **Work with these modified (no_DC) signals for the rest of the project.** In this case the specific amount of offset in each signal is not known.

In your report, include a sketch showing the location of the three electrodes, Pz, Cz, and Fz, on the head.

II. OBJECTIVE:

The overall objective of the assignment is that you combine your basic knowledge of the broad anatomy of the brain (localization of the cerebral lobes), your acquaintance with the 10-20 International Systems of Electrode Placement for EEG recording and the broad association with relative contributions of the EEG frequency "bands" or rhythms, as well as your capability of designing digital filters and analyzing a discrete-time series, TO LABEL STATE 1 and STATE 2 as "AWAKE_RELAXED" vs. "AWAKE_ATTENTIVE".

III. EEG BAND POWER ASSESSMENT BY FILTERING AND MEAN SQUARES

Your approach to identifying the nature of State1 and State 2 will consist of identifying the approximate power contribution of the relevant EEG frequency bands to the total EEG power in each record, by digital filtering and assessment of the sum of squares (AC power) of the output of the filters.

Design two bandpass filters (your choice of FIR or IIR):

"A filter": to isolate the alpha and beta I bands (8 - 17 Hz),
"B filter" to isolate the beta II band (18 - 40 Hz)

The filters must have unity gain in their pass bands and at least 20 dB attenuation in their stop-bands (i.e. outside of the frequency ranges specified above). You will determine the type and order of the filter.

Verification of the filters: Plot the magnitude response of the filters, in dB. (This can be done very simply using the command "freqz" in Matlab). Show the magnitude response of both filters superimposed.

Calculate the average of the squared values in:
a) The original, or **total** signal (MS_T);
b) The output of the **A** filter (MS_A)
c) The output of the **B** filter (MS_B)

For each record determine:
$$AT = MS\_A / MS\_T$$
$$BT = MS\_B / MS\_T$$

According to the values of AT and BT for each record, in each state, propose the identification of the states.

In order to properly justify your labeling of the sets of signals:

a) Develop a graph or table showing simultaneously the AT and BT ratios for all three electrode locations, and for both states.
b) Describe your observations from that table or graph.
c) Contrast your observations with the known relationship of the presence and location of alpha and beta rhythms and the state of relaxation or attentiveness of an adult awake subject.
d) Comment on why the AT, BT ratios obtained under both states will lead you to label each state in a particular way.
e) Indicate clearly how, in your opinion, each set of signals should be labeled ("AWAKE_RELAXED" vs. "AWAKE_ATTENTIVE").

NOTES:

[a] This is an INDIVIDUAL project – Each student will work separately and submit one report
[b] The report must be a complete printed report, but, in addition, it must include a properly LABELED (with YOUR NAME) CD, containing all the data and programs involved in this project