KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
COLLEGE OF COMPUTER SCIENCES & ENGINEERING
COMPUTER ENGINEERING DEPARTMENT

COE-341 – Data and Computer Communication

Matlab Programming Assignment #2: Fourier Series Expansion & Filtering – Due Date April 24th, 2010 – In Class.

[100 points] Consider the periodic square wave signal $s(t)$ shown in Appendix A Table A.1 (page 838 of textbook).

a) **[35 points]** Write a Matlab code to evaluate $s(t)$ and $s\_e(n = k)$ for any $k = 1, \ldots, \infty$. The code prompts the user to enter a specific value for k. The code should plot the original $s(t)$ and also the $s\_e(n = k)$ for $k = 0$, 1, 3, and 10 on the same plot.

- Use different line styles and colors (as in class notes) for each of the two curves of the plot and identify the individual curves using the "`legend`" command of Matlab. The code (and built in formulas in the code) should be general and and interms of the variables T, and A.
- Add the proper labels (x and y).

The expected output: One figure with the curves for $s(t)$, $s\_e(n=0)$, $s\_e(n=1)$, $s\_e(n=3)$, and $s\_e(n=10)$ with proper legend and labels. Comment on the $s\_e(n=k)$ as k increases and its relation to $s(t)$.

b) **[35 points]** Extend the Matlab code done for (a) to evaluate the PSD function for $s(t)$ as well. On a separate figure plot the PSD function for k equal to 10. Use the "stem" Matlab command for plotting and label your axes properly.

The expected output: One figure with the curves for the PSD function for $s\_e(n=10)$ with proper legend and labels. ***Comment*** on the theoretical and effective bandwidth for $s(t)$. See the discussion on bandwidth in textbook page 72.

c) **[30 points]** Extend the Matlab code done for (b) to plot a third figure that shows the percentage of power contained in $s\_e(n=k)$ relative to original power in $s(t)$. This percentage (y-axis) is plotted versus k (x-axis). Let the x-axis represents k from 0 to 20 in steps of 1. You should observe that this percentage approach 100% as k increases. From the figure determine minimum n^* such that $s\_e(n = n^*)$ contains at 97% of power or more.

The expected output: One figure showing percentage power contained in $s\_e(n=k)$, relative to that in $s(t)$, versus k with proper legend and labels. **Show** on your figure, the min n^* that corresponds to 97% of power.

A problem similar to this is solved in class notes. The corresponding Matlab code is listed in the slides as well. The required mathematical expressions are found in the textbook section 3.1 and Appendix 1.

This student MUST show the expressions (FSE, power calculations, PSF function, etc.) the Matlab code is plotting. These must be included in report and BEFORE the plots

(a), (b), and (c). The student must submit the code listed along with the programming assignment write up.

The developed Matlab code should be very organized and well documented. Use variable names identical or very close to the mathematical variable used in this problem statement. The documentation should clearly specify the sections of the code that correspond to each part of this programming assignment.

Students are encouraged to cooperatively discuss the problem and the Matlab know-how, however, when it comes to writing the code, each student must write and submit his own code. The submitted codes will be inspected for similarities.

Answer the parts (a), (b), and (c), generate the required output, import them into a Microsoft word file (see the sample below), and provide your comments as stated in the problem statement. Zip the word file together with the Matlab code and submit the zipped file by email to: g200802800@kfupm.edu.sa (Our TA Eng. Irfan Khan) and ashraf@kfupm.edu.sa (The instructor). The name of the zipped file should be according to the following pattern: `sXXXXXX_LastName_FirstName_ProgAssigBonus.zip`. sXXXXXX is the student number.

To import figures into your word document, go to the Matlab figure Edit menu and select "copy figure". Paste (special) the figure into the word file as "Picture (Enhanced Metafile)". Please do not paste as any other format.

Students must ALSO submit a hardcopy of the programming assignment solution and the used Matlab code.