

ARIZONA STATE UNIVERSITY
DEPARTMENT OF ELECTRICAL ENGINEERING
EEE 404/591 Spring 2009
Problem Set #3

Assigned: 4 March 2009

Due Date: 25 March 2009

Reading: Read Sections 6.1 and 6.2 (pages 305 to 333) in Chapter 6 and Section 1.7 (pages 29 to 38) in Chapter 1 of the Kuo & Gan textbook.

Announcement: Exam 1 will be held on Wednesday 18 March 2009 during class time. Online students should arrange with their proctors to take Exam 1 on Wednesday 18 March 2009. The Exam will cover the class lecture material, reading, and problems assigned in homeworks 1 and 2. Exam 1 will be *closed book* and *closed notes*. Only one $8\frac{1}{2} \times 11$ page of *hand-written* notes is allowed. No calculators and no other devices are allowed, except for a pencil, pen, eraser, and ruler.

PROBLEM 3.1:

MATLAB EXERCISE (6 points): Perform the following experiment with MATLAB (*For help, use the commands **help** and **lookfor**; for information about these commands, run Matlab and type **help help** and **help lookfor**; you could also consult the Matlab guides available on www.mathworks.com*):

1. Perform the tutorial on how to use the Matlab filter design and analysis tool **fdatool**, given in Section 6.2 (pages 324 to 332) in Kuo & Gan.
2. Use the filter design and analysis tool **fdatool** in Matlab to design a lowpass FIR equiripple (also known as minimax) filter with the following specifications: filter order = 10; passband and stopbands weights are 1; passband cutoff frequency $F_{\text{pass}} = 6000$ Hz; stopband cutoff frequency $F_{\text{stop}} = 14400$ Hz; sampling frequency $F_s = 48000$. Display and submit the magnitude response, the impulse response, and the filter coefficients of the designed filter.
3. Turn on the quantization mode using the **Set quantization parameters** icon located in the side bar on the left, and choose **Fixed-point** for the filter arithmetic. Also, choose a Q15 format for the filter coefficients. Display and submit the magnitude response, the impulse response, and the filter coefficients of the resulting filter, and compute the mean squared quantization error.
4. With the quantization mode turned on, choose a Q6 format for the filter coefficients. Display and submit the magnitude response, the impulse response, and the filter coefficients of the resulting filter, and compute the mean squared quantization error.

PROBLEM 3.2:

Problem B-3-14 in Kuo & Gan.

PROBLEM 3.3:

Consider a 3×3 gray scale image with intensities x_i as shown below:

x_i :

0	2	3
2	1	2
3	3	2

- (a) Plot the histogram of this image x_i .
- (b) We wish to perform histogram equalization on the the gray scale of the image x_i . Following the procedure presented in class, determine the resulting equalized histogram.
- (c) Determine the histogram-equalized image x_o .