

Homework #6

Carrier Recovery, Timing Recover and QAM Transmission

Assigned on Saturday, April 5th, 2014

Due on Friday, April 11th, 11:00am sharp

Homework submitted after 11:00am will be subject to a penalty of 2 points per minute late.

Reading: Johnson, Sethares & Klein, sections 10.1-10.4, 12.1-12.4 and 16.1-16.2

This assignment is intended to continue building our foundation for transmitter and receiver design.

Office hours for the teaching assistants and Prof. Evans; **bold** indicates a 30-minute timeslot:

<i>Time Slot</i>	<i>Monday</i>	<i>Tuesday</i>	<i>Wednesday</i>	<i>Thursday</i>	<i>Friday</i>
9:30 am					Jia (ENS 137)
10:00 am					Jia (ENS 137)
10:30 am					
11:00 am	Evans (ETC 5.148)		Evans (ETC 5.148)		Evans (ETC 5.148)
12:00 pm	Evans (ETC 5.148)		Evans (ETC 5.148)		Evans (cafe)
12:30 pm				Evans (ENS 433B)	Evans (cafe)
1:00 pm				Evans (ENS 433B)	
2:00 pm				Evans (ENS 433B)	
2:30 pm			Sinno (ENS 137)		
3:00 pm			Sinno (ENS 137)		
3:30 pm			Sinno (ENS 137)	Jia (ENS 137)	
4:00 pm			Sinno (ENS 137)	Jia (ENS 137)	
4:30 pm				Jia (ENS 137)	
5:00 pm				Jia (ENS 137)	
5:30 pm				Sinno (ENS 137)	
6:00 pm				Sinno (ENS 137)	

You may use any computer program to help you solve these problems, check answers, etc. ***Please submit any MATLAB code that you have written for the homework solution.*** The MATLAB code in the Johnson, Sethares and Klein book also runs in LabVIEW Mathscript and GNU Octave. Please see the note on page vii of the SRD book for more information

As stated on the course descriptor, “Discussion of homework questions is encouraged. Please be sure to submit your own independent homework solution.”

Please fully justify your answers on each homework problem using Matlab code, Matlab plots, and mathematical analysis.

6.1 Phase Locked Loop. 42 points.

Johnson, Sethares & Klein, exercise 10.17, on pages 205-206.

This phase locked loop uses the squaring block as employed in the pre-emphasis of problem 5.3.

6.2 Timing Recovery. 28 points.

Johnson, Sethares & Klein, exercise 12.10, on page 264.

6.3 Simulation of 4-QAM and 16-QAM Transmission. 30 points.

Johnson, Sethares & Klein, exercise 16.2, on page 363.

Please see Fig. 16.12 on page 381 and read accompanying text. Plotting symbol error rate vs. signal-to-noise ratio is a very common first step in analyzing communication system performance. This curve plots the lower bound from a formula. Another way to use this graphical representation is to simulate a communication system for different SNR settings and scatter plot the results. This could allow comparison of two equalization methods, two timing recovery methods, etc. Superimposing the lower bound from a formula on the plot shows how close (or far away) the methods are from the ideal answer.