Department of Electrical Engineering
IIT Madras, Chennai 600 036.

EE 4140- Digital Communications
July–November 2018

Computer Assignment Submission Instructions

- Submit the assignment individually or as team of two students
- Please submit the following
  - Required plots
  - Include brief explanation of observations, as appropriate
- The submitted file should be in .pdf format
- Mention name and roll number of both team members
- Use following naming convention for file
  - roll_number_assign#.pdf
  - example:EE15Bxxx_assign1.Pdf
  - (Use roll number of one of the team members)
- Assignment submission via Moodle
  - Instructions given by TAs
  - Do not send via email
- Honour Code:
  - Add this line to your assignment and an electronic signature
  - I certify that this assignment submission is my own work and not from obtained from any other source

Prof. David Koilpillai

Phone: +91-44-2257-4405

koilpillai@ee.iitm.ac.in

FAX: +91-44-2257-0120

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Computer Assignment - 1 (Due date: August 19, 2018)

1. Consider the passband signal $u_p(t) = sinc(t)\, cos 20\pi t$, where the unit of time is in microseconds.

a) Use Matlab to plot the signal (plot over a large enough time interval so as to include “most” of the signal energy). Label the units on the time axis.

Remark: Since you will be plotting a discretized version, the sampling rate you should choose must be large enough that the carrier waveform looks reasonably smooth (e.g., a rate of at least 10 times the carrier frequency).

b) Write a Matlab program to implement a simple downconverter as follows.Pass $x(t) = 2u_p(t) cos 20\pi t$ through a lowpass filter which consists of computing a sliding window average over a window of 1 microsecond. That is, the LPF output is given by $y(t) = \int_{t-1}^{t} x(\tau)\, d\tau$. Plot the output and comment on whether it is what you expect to see.

2. The Square Root Raised Cosine (SRRC) pulse is commonly used in wireless communications. The expression of the impulse response is given below:

$$h(t) = \begin{cases} 1-\alpha+4\dfrac{\alpha}{\pi}, & t=0 \\ \dfrac{\alpha}{\sqrt{2}}\left[\left(1+\dfrac{2}{\pi}\right)\sin\left(\dfrac{\pi}{4\alpha}\right)+\left(1-\dfrac{2}{\pi}\right)\cos\left(\dfrac{\pi}{4\alpha}\right)\right], & t=\pm\dfrac{T}{4\alpha} \\ \dfrac{\sin\left[\pi(1-\alpha)\dfrac{t}{T}\right]+4\alpha\dfrac{t}{T}\cos\left[\pi(1+\alpha)\dfrac{t}{T}\right]}{\pi\dfrac{t}{T}\left[1-\left(4\alpha\dfrac{t}{T}\right)^2\right]}, & \text{for all other } t \end{cases}$$

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where α is the roll-off factor. Plot the normalized frequency response $20\log log\, H(e^{j\omega})$ vs ω computed via DFT for the following values of roll-off factor : α = 0.35, 0.7 and 1.0. Use 8X oversampling factor in the representation of the SRRC pulse and a truncation length of 10 symbols. Assume that the symbol rate is 25 K symbols/sec.

(Note: You should not use MATLAB built-in function for generating the SRC pulse)

3. ***Verification of ISI-free property of RC pulse*** :

   a) Generate the SRRC as defined in question 2.

   b) Convolve the SRRC pulse with itself to get an RC pulse (SRRC * SRRC).

   c) Take a random sequence of 20 bits (± 1). Apply RC pulse shaping to this data sequence.

   d) Select the samples the resultant waveform at symbol-spaced sampling points which correspond to the peak of the RC pulse.

   e) Write down the values of the samples.

   f) Observe that there is no ISI at the ideal sampling points.

   g) For this sequence, generate the eye diagram (to show the optimum sampling point).

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