

# Birla Institute of Technology & Science, Pilani, Rajasthan

First Semester 2019-2020

## Lab 10 (Thursday)

Course: EEE F311 Communication Systems  
Instructor-in-Charge: S M Zafaruddin

Date: 15-11-2019

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### Objectives

- BER.
- Channel effects.

### Task 1

1. Write your first name (maximum 6 letters), assign probabilities (See Table) to each alphabet, and then code each letter using Shannon-Fano source encoding. It is better to code using pen and paper. The encoded bits will be data stream to be transmitted over a channel.
2. Transmit your first name using binary bandpass BPSK modulation using raised cosine pulse  $x(t) = PX \frac{\cos(\pi R_b t)}{1-4R_b^2 t^2} \text{sinc}(\pi R_b t) \cos(2\pi f_c t)$ , where  $X$  is one of the BPSK constellation points taken randomly, and  $P = 23\text{dBm}$  is the transmitted power. The signal is transmitted over a channel  $h(t) = \sqrt{\frac{G_t G_r \lambda^2}{16\pi^2 d^2}} \delta(t)$ , where  $G_t = G_r = 10\text{dB}$ , and distance  $d = 100$ . Take a carrier frequency 890MHz, channel bandwidth 1 Hz, and  $N_0/2 = -174\text{ dBm/Hz}$ . Using the real time code to show the transmitted pulse and received pulse in two different subplots.

### Task 2

1. Generate a 4-QAM constellation where each constellation point has unit energy. Randomly select one of the constellation point, multiply it with  $\sqrt{P}$ , where  $P = 23\text{ dBm}$ , and transmit it over a random Gaussian channel with zero mean and variance 1. Add Gaussian noise of PSD  $N_0/2 = -174\text{ dBm}$ . In summary, you need to generate  $Y = \sqrt{P}HX + W$ . Plot the transmitted constellation (in one subplot) and received signals (in second subplot) by transmitting many symbols.
2. Assuming known channel, plot the absolute value of error in symbol detection for each symbol if 100 symbols are transmitted. Y-axis: error, xaxis: number of symbols.

**TABLE P.13.1-5**

Probability of Occurrence of Letters in the English Language

Letter	Probability	$-\log P_i$
Space	0.187	2.46
E	0.1073	3.22
T	0.0856	3.84
A	0.0668	3.90
O	0.0654	3.94
N	0.0581	4.11
R	0.0559	4.16
I	0.0519	4.27
S	0.0499	4.33
H	0.04305	4.54
D	0.03100	5.02
L	0.02775	5.17
F	0.02395	5.38
C	0.02260	5.45
M	0.02075	5.60
U	0.02010	5.64
G	0.01633	5.94
Y	0.01623	5.95
P	0.01623	5.95
W	0.01620	6.32
B	0.01179	6.42
V	0.00752	7.06
K	0.00344	8.20
X	0.00136	9.54
J	0.00108	9.85
Q	0.00099	9.98
Z	0.00063	10.63

## Backup Codes

1. Please keep backup of codes and figures by sending to your emails.
2. Make a zip/rar folder of your codes and figures in .jpeg format and upload to (ONLY ONCE):  
<https://www.dropbox.com/request/wcMxxj26IxIbidAFiLhB>

## Project Task

We have started individual tasks with a bigger picture: to design an end-to-end simulator. Study the structure module in Matlab. Create a function of source signal as a structure and field values as the signals discussed so far: sinusoidal signal , rectangular pulse, audio file.