EE340 – Communications Laboratory (IIT Bombay)

Mid-Sem Exam Batch B: Wednesday, Sept. 3, 2015; 14:00 – 16:00 hrs Max. Marks: 20

Roll No.: _____ TA/RA Name(s): _____

IMPORTANT INSTRUCTIONS: Save all the snapshots and GNU-Radio files you've made in a folder (named as your roll number). You have to provide this folder to your TA at the end of the session and attach the question paper to the answer scripts you are submitting. Also, don't forget to get signatures of your TA at the front page bottom right corner of your answer book when you submit your folder and the answer script. If some simulation parameters are not provided, choose them yourself appropriately so that your simulation results are not affected by them significantly. Also make sure that your axes in the plots are marked properly.

1. (a) Use Noise Source, Low Pass Filter and IIR blocks in GNU-Radio to obtain two signals with power spectral densities (PSDs) that roughly resemble the PSDs shown in Fig. 1a. Use the sample rate of 1 MHz. *[4]*

   (b) From the signals obtained in Part (a), generate signals with PSDs shown in Fig. 1b. *[2]*

   (c) Signals similar to what you should obtain in Part (b) have been provided in the files named `Prob1_BatchB_square.wfm` and `Prob1_BatchB_triangle.wfm`. Use the signals provided in these files (DO NOT use the signals from Part (a) or Part (b) directly) to generate a signal with PSD shown in Fig. 1c. To use these files, use the block 'File Source' with 'Repeat=Yes'. The output data type is 'float' and the sample rate is 1 MHz. *[4]*

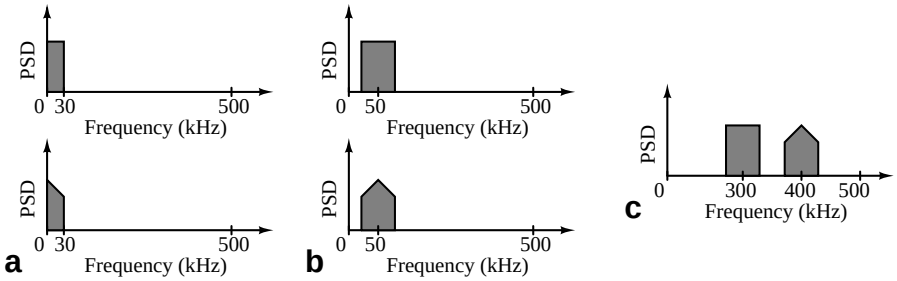

Figure 1: Single-balanced mixer for DSB-FC modulation.

2. The filename `Prob2_BatchB_FM.wfm` contains a real signal that is available at the receiver antenna and has been sampled using an analog-to-digital converter at 1 MHz sample rate. It basically contains an FM signal with 100 kHz carrier frequency and three tones between 0.5 kHz to 15 kHz as the message signal. The tones were frequency modulated after applying pre-emphasis (as discussed in Experiment 5). *[6+4]*

   (a) Make a flow-graph to demodulate the message from this signal (you do NOT have to apply de-emphasis in this part). Show the obtained message signal spectrum with noise peaking behaviour. What are the three tone frequencies?

   (b) Apply a de-emphasis filter (using the IIR filter block) and adjust the time constant to obtain equal amplitudes for the three tones. Show the resultant spectrum and calculate the corner frequency and time constant (τ) of the de-emphasis filter for which the tone amplitudes are constant.