

Department of Electrical Engineering  
EC-305 Communication Systems

Sept. 8, 2009

**Quiz #1**

20 marks

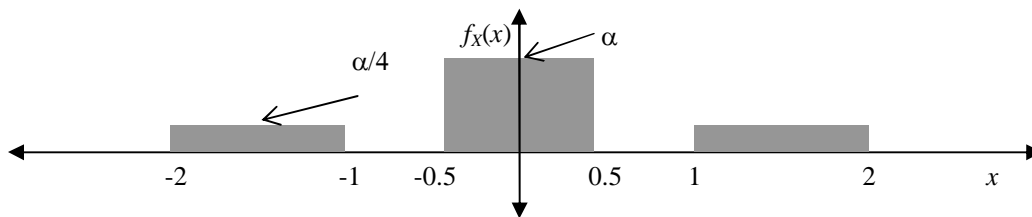
1. [3 marks] A low-pass signal of one-sided bandwidth of  $W=1.25\text{MHz}$  is sent as a DSB-SC signal. If the receiver uses an IF sampling scheme, with center frequency  $f_{\text{IF}} = 71\text{MHz}$ , determine the least sampling rate required.

2. [1+2+4 = 7 marks] A signal  $x$ , described by the pdf  $f_X(x)$  as below, is to be quantized:

(a) For what value of  $\alpha$  is this a valid pdf ?

(b) Find the quantization error variance  $E_q$  for a 2-bit uniform quantizer with left-most quantization interval  $a_1=-1$ , and  $\Delta=1$ . (*Hint*: use these to define the other quantization intervals, and the quantization levels  $\{ \hat{x}_1, \hat{x}_2, \dots, \hat{x}_N \}$ ).

(c) Now, define the non-uniform 2-bit quantizer for this pdf, where the above uniform quantizer can be taken as the initial guess. Use the practical approach to implement the Lloyd-Max rule, and run it over 3 iterations. How does the  $E_q$  of this compare to case (b)?



3. [1+1+1.5+1.5=5 marks] For a bit-stream with 12 consecutive bits given by 1,0,0,0,0,1,0,0,0,1,1,1, make a rough plot of the following line-codes: (a) Coded Mark Inversion (CMI) (b) Differential Split-phase Manchester (c) B3ZS and, (d) HDB3

4. [5 marks] State whether True (T) or False (F). If False, provide the correct statement to claim credit.

(i) The Echo Canceller is not only computationally cheaper when compared to the Echo Suppressor, but also provides a much better approach to cancel the echoes in the telephone network. (T/F)

(ii) Granular noise is caused in Delta modulation when there are rapid changes in the input speech signal amplitude. (T/F)

(iii) Code Excited Linear Prediction (CELP) methods are powerful waveform coding techniques that provide very low coded bit-rates for speech. (T/F)

(iv) Alternate Mark Inversion is more power-efficient and band-width efficient when compared Differentially encoded split-phase Manchester coding, but cannot provide timing support always.

(v) When 4 additional bits can be accommodated in an uniform quantizer, the SQNR will increase by 16dB. (T/F)