King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE573: Digital Communications II (112)
Quiz 1: Band-limit Communications
Dr. Ali Muqaibel

Serial #

Name: KEY

Complete the following:

Nyquist Pulse-Shaping Criterion or Nyquist Criterion for Zero ISI: The necessary and sufficient condition for $x(t)$ to satisfy $x(nT) = \begin{cases} 1 & n = 0 \\ 0 & n \neq 0 \end{cases}$

is that its Fourier transform $X(f)$ satisfies… $\sum_{m=-\infty}^{\infty} X\left(f + \frac{m}{T}\right) = T$.. **(2 points)**

For modified duobinary

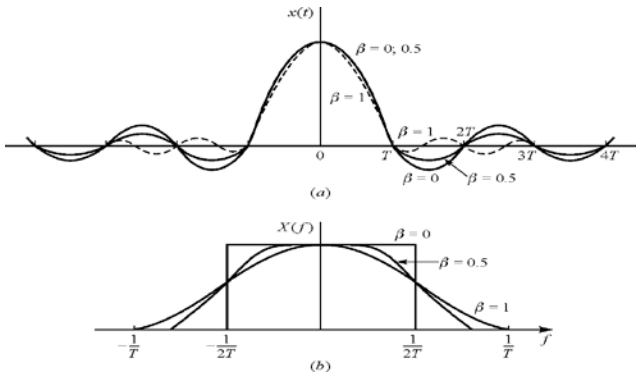
$$x\left(\frac{n}{2W}\right) = x(nT) = \begin{cases} 1 & n = -1 \\ -1 & n = 1 \\ 0 & otherwise \end{cases}$$

Complete the following table

D_m	1	1	1	0	1	0	0	1
I_m	+1	+1	+1	-1	+1	-1	-1	+1
B_m	1	0	-2	0	0	-2	+2	1

(2 points)

Sketch the time domain waveform and spectrum for the raised cosine for roll-off factor of $\beta = 0\ and\ \beta = 1$. (Show all important difference) **(3 points)**



A 4-kHz band-pass channel is to be used for *M*-ary transmission of data at a rate 9600 bits/s. If we use a signal pulse with a raised cosine spectrum having an excess bandwidth of at least 60%, what is the value of *M* ? what is the used roll-off factor with the chosen *M*? **(3 points)**

For Baseband $BW = \frac{R}{2} + \frac{\beta R}{2}$ but for band-pass $BW = (1+\beta)R$, where R is the symbol rate. We can also write $BW = \frac{(1+\beta)\,R_b}{k}$ where $k = \log_2 M$

By substitution $\frac{4000}{9600}\ k = 1 + \beta$, which means that $\frac{4000}{9600}\ k > 1 + 0.6$, the min value of k that satisfies the requirements is $k = 4$, which means $M = 2^4 = 16$. If we substitute in the original equation we get $\beta = 0.6667$.

Good Luck, **Dr. Ali Muqaibel**