King Fand University of Petroleum & Minerals
Electrical Engineering Department
EE573: Digital Communications II (092)
Quiz 1: Band-limit Communications
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Serial: 0

Name: KEY

State **T**rue or **F**alse . *If False state why?* (5 points)

a) Any channel that has a constant amplitude response is a non-distorting channel. (F)

The phase response must be linear

b) We should be more concerned about ISI and channel impairments as W/R increases. (F)

R/W

c) The eye pattern illustrates the effect of ISI but does not include the effect of noise. (F)

It illustrates the combined effects

d) One advantage of modified duo-binary over duo-binary pulses is zero DC. (T)

e) Symbol-by-symbol detection of partial response signaling is suboptimal. (T)

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f) Mention one advantage for pre-coding in duo-binary signaling? **(1 point)**

To avoid error propagation in decoding

g) For a baseband system 8-ary, the available bandwidth is 10 *k*Hz and the roll-off factor is 0.25, what is the data rate (bits/sec)? **(1 point)**

$$W = \frac{R}{2} + r\frac{R}{2} = (1+r)\frac{R}{2} \Rightarrow R = \frac{2W}{1+r} = \frac{20k}{1.25} = 16\,K\ \frac{\text{Symbols}}{\text{sec}}$$

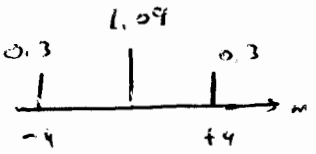
$$\Rightarrow \quad 16K \cdot \frac{\text{symbols}}{\text{sec}} \cdot \log_2 8\ \frac{\text{bits}}{\text{symbol}} = 48\,K\ \frac{\text{bits}}{\text{sec}}$$

h) The elements of the sequence $\{a_n\}_{n=-\infty}^{\infty}$ are independent uncorrelated +1 or -1 with equal probability. If we code the input sequence as $b_n=a_n+0.3a_{n-4}$, What is the autocorrelation function $\phi_b(m)$. Find and simplify the power spectral density $\Phi_b(f)$. **(3 points)**

$$\phi_b(m) = E[b_n\, b_{n+m}] = E[(a_n+0.3a_{n-4})(a_{n+m}+0.3a_{n+m-4})]$$

$$\delta(t-t_0) = \exp(-j2\pi f t_0)$$
$$2\cos\theta = \exp(j\theta) + \exp(-j\theta)$$

$$= E[a_n a_{n+m}] + E[0.3a_{n-4}a_{n+m}] + E[a_n\, 0.3a_{n+m-4}]$$
$$+ E[0.09\, a_{n-4}\, a_{n+m-4}]$$
$$= \delta_m + 0.3\delta_{m+4} + 0.3\delta_{m-4} + 0.09\delta_m$$
$$= 1.09\delta_m + 0.3\delta_{m+4} + 0.3\delta_{m-4}$$



$$\Phi_b(f) = 1.09 + 0.6\cos(2\pi f 4T)$$

Good Luck, **Dr. Ali Muqaibel**