King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE370: Communications Engineering I (072)
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Quiz 6: Digital Transmission

Serial # 0

-1 points for not writing your serial #

Name: KEY

In a certain digital voice communication system, there are 4 voice signals, each of bandwidth 4 kHz. Samples of these signals are time-division multiplexed, quantized and binary coded. The error in sample amplitudes cannot be greater than 3% of the peak amplitude.

a) Determine the number of bits for the quantizer, *n*.

① $\frac{\Delta v}{2} \le 0.03 m_p$ — ① & $\Delta v = \frac{2m_p}{L}$ — ② ①

Substitute ② in ①

4 ① $\frac{m_p}{L} \le 0.03 m_p \Rightarrow L \ge \frac{100}{3} = 33.333$

$n = 5 \Rightarrow L = 2^n = 32$

① $n = 6 \Rightarrow L = 2^6 = 64$ ✓ $\boxed{n = 6}$

b) Find the transmission bandwidth B_T if Nyquist criterion pulses with roll-off factor r=0.3 are used. The sampling rate must be at least 15% above the Nyquist rate.

① Nyquist rate = $2(4\,KHz) = 8\,KHz$ or $8K \frac{samples}{sec}$

① Sampling rate = $1.15\,(8K) = 9.20\,KHz$

① # of bits = $9.2\,K \frac{samples}{sec} * 6 \frac{bits}{sample} = 55.2\,K \frac{bits}{sec}$

① 4 users total rate ⇒ $55.2K * 4 = 220.8\,K \frac{bits}{sec}$

① Binary: Base band $B_T = \frac{R}{2} + r\frac{R}{2} = \frac{(1+r)}{2} R$

$B_T = \frac{1.3}{2}(220.8K) = 1.3(110.4K)$

$= 143.52\,KHz$

3312
11040
14352

①