Data Transfer HW 1

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Contents

0.1 Question 1

0.1.1 A

$P_{tx} = 10$

$Att = -20db$

$P_{rx} = ?$

$att = 10 * \log_{10}\left(\frac{P_{rx}}{P_{rx}}\right) \implies -20 = 10 * \log_{10}(\alpha) \implies \alpha = 10^{-2}$

$\alpha = \left(\frac{P_{rx}}{P_{tx}}\right) \implies \left(\frac{P_{rx}}{10}\right) = \frac{1}{100} \implies P_{rx} = \frac{1}{10}watt \implies P_{rx} = 10^2 MilliWatt$

0.1.2 B

0.2 Question 2

$TotalAttenuation = -12 + 35 - 10 = 13db$

$+13 = 10 * \log_{10}\left(\frac{P_{rx}}{4}\right) \implies 10^{1.3} = \left(\frac{P_{rx}}{4}\right) \implies P_{rx} = 79.8$

0.3 Question 3

0.3.1 A

$Nyquist : C = 2 * W * m$

$m = \log_2 M$

$M = 32 \implies C = 2 * 10K * \log_2 32 \implies C = 2 * 10K * 5 = 100kb/s$

$C = 10^5$

0.3.2 B

$C = BW * \log_2\left(1 + \frac{S}{N}\right) \implies 100K = 10K * \log_2\left(1 + \frac{S}{N}\right) \implies 10 = \log_2\left(1 + \frac{S}{N}\right) \implies 2^{10} = 1 + \left(\frac{S}{N}\right) \implies$

$\left(\frac{S}{N}\right) = 1023$

$$SNR = 10 * \log_{10}\left(\tfrac{S}{N}\right) \implies SNR = 10 * \log_{10} 1023 \implies SNR \approx 30 db$$

0.3.3 C

$$C_{new} = 2 * C_{old} \implies C_{new} = 2 * 100kb = 200kb = 2 * 10^5 b$$

$$2 * 10^5 = 10^4 * \log_2\left(1 + \tfrac{S}{N}\right) \implies 20 = \log_2\left(1 + \tfrac{S}{N}\right) \implies \tfrac{S}{N} + 1 = 2^{20} \implies \tfrac{S}{N} = 2^{20} - 1$$

$$SNR = 10 * \log_{10} \tfrac{S}{N} \implies SNR = 10 * \log_{10} 2^{20} - 1 \approx 60 db \implies SNR \approx 60 db$$

0.4 Question 4

WaitingForHanie

0.5 Question 5

$$\log_{10}\left(\tfrac{E_b}{N_0}\right) = 4.2 db$$

$$E_b = S * T_b = \tfrac{S}{R} \implies \left(\tfrac{E_b}{N_0}\right) = \left(\tfrac{S}{RN_0}\right) = \left(\tfrac{S}{RKT}\right)$$

$$\implies 10\log_{10}\left(\tfrac{E_b}{N_0}\right) = 10\log_{10}(S) - 10\log_{10}(RKT) \implies 10\log_{10}(S) = 10\log_{10}(RKT) + 10\log_{10}\left(\tfrac{E_b}{N_0}\right) \implies$$

$$10\log_{10}(S) = 10\log_{10}(RKT) + 4.2 \implies 10\log_{10}(S) = 10\log_{10}(270 * 3600 * 1.38 * 10^{-23}) + 4.2 \implies$$

$$10\log_{10}(S) = -164.67 \implies \log_{10}(S) = -16.467 \implies S = 10^{-16.46} \approx 10^{-16}$$

0.6 Question 6

0.7 Question 7

0.8 Question 8

0.8.1 A

$InFSK : F_g{>}0 \implies f_s - \frac{R}{2}{>}0 \implies f_s - 1000 > 0 \implies f_s > 1000$

$IAssumethat f_s = 1200 \implies f_g = 200$

$BW = 1200 + 1000 = 2200$

0.8.2 B

In ASK : $BW = 2f_0 = R = 2kHz$

0.8.3 C

Both FSK and PSK are calculated with the same formula $\implies BW = 2f_0 = R = 2kHz$

0.9 Question 9

$10\log_{10}\left(\frac{E_b}{N_0}\right) = 10\log_{10}\frac{S}{N} + 10\log_{10}W - 10\log_{10}R \implies 18 = 15 + 10\log_{10}\frac{S}{R} \implies 3 = 10\log_{10}\frac{W}{R} \implies$

$\left(\frac{W}{R}\right) = 10^{0.3} \implies B = \left(\frac{R}{W}\right) = \frac{1}{10^{0.3}} \approx 0.5$