

1. (Textbook problem 10.11 modified) Consider the transmission of data via PAM with a raised-cosine spectrum over a channel that has a bandwidth of 20 kHz. Show how the symbol rate varies as a function of the excess bandwidth α . In particular, determine the symbol rate for excess bandwidths of 25%, 33%, 50%, 67%, 75%, and 100%.
2. *Modify* MATLAB script `eyediagram.bpsk2.m`, available in Canvas, in order to produce the eye diagrams corresponding to BPSK modulation (polar mapping) with raised-cosine pulses of rolloff factor value α equal to:
 - (a) 0.25
 - (b) 0.5
 - (c) 0.9
3. A wireless data link operates over a UHF channel of center frequency $f_c = 915$ MHz bandwidth $B = 1$ MHz. A raised-cosine spectrum is used to remove ISI, the modulation scheme is QPSK and the desired bit error probability is 10^{-3} .
 - (a) Sketch carefully the amplitude of the overall *lowpass equivalent* frequency response for the following values of rolloff factor:
 - i. $\alpha = 0.9$
 - ii. $\alpha = 0.5$
 - iii. $\alpha = 0.25$
 - (b) For each of the rolloff values in part (a) above, find:
 - i. The symbol rate R and the bit rate R_b
 - ii. The required signal-to-noise ratio (SNR)¹ in dB.

¹The signal-to-noise ratio is given by $\left(\frac{S}{N}\right) = \frac{R}{B} \left(\frac{E_s}{N_0}\right)$, where $B = 2W$ is the RF signal bandwidth.