

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  $\alpha$ . 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  $\alpha$  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)<sup>1</sup> in dB.

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