

S-72.3410 Coding Methods

1. (6p.) Consider the rate-1/3 convolutional code defined by the transfer-function matrix

$$\mathbf{G}(D) = \begin{bmatrix} 1 + D^2 & D & D + D^2 \end{bmatrix}.$$

Draw the encoder circuit, and the encoder state diagram. Find the minimum free distance of the code. Is the code systematic or non-systematic?

2. (6p.) Find a generator polynomial for a 9-ary 2-error-correcting Reed-Solomon code of length 8. What is the rate of this code? (*Hint:* You may find the following information useful: the polynomials $p_1(x) = x^2 + x + 2$ and $p_2(x) = x^2 + 2x + 2$ are primitive in $\text{GF}(3)[x]$.)

3. (6p.) A systematic (6,3) code has the generator matrix

$$\mathbf{G} = \begin{bmatrix} 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}.$$

Construct a standard array and the corresponding syndrome table for this code.

4. (6p.)
- (2p.) Describe, briefly and on a general level, the main *differences* between, on one side, turbo and LDPC codes, and, on the other side, codes that have traditionally been used for error-correction (BCH, Reed-Solomon, convolutional and other codes).
 - (4p.) Construct a parity check matrix of the code in Problem 3 above. Draw a Tanner graph corresponding to the parity check matrix obtained.