

S-72.3410 Coding Methods

1. (6p.) Consider the (2,1,3) convolutional code with $\mathbf{G}(D) = [1 + D^2 \quad 1 + D + D^2 + D^3]$.
 - (a) Find the GCD (greatest common divisor) of its generator polynomials.
 - (b) Draw the encoder state diagram.
 - (c) Find an infinite-weight information sequence that generates a code word of finite weight.
 - (d) Is this code catastrophic or non-catastrophic?

2. (6p.) Consider the 4-ary code \mathbf{C} defined by the following parity-check matrix, where α is primitive in $\text{GF}(4)$.

$$\mathbf{H} = \begin{bmatrix} \alpha & \alpha^2 & 1 & 1 \\ \alpha^2 & \alpha & 1 & 0 \end{bmatrix}$$

Find a systematic generator matrix for the code \mathbf{C} . Also write out the 16 codewords in \mathbf{C} .

3. (6p.) Define or explain briefly the following concepts:
 - (a) maximum a posteriori (MAP) decoding
 - (b) punctured block code
 - (c) hybrid ARQ
 - (d) minimal polynomial of a field element
 - (e) minimum free distance of a convolutional code
 - (f) maximum distance separable (MDS) code
4. (a) (3p.) Describe the retransmission mechanisms in stop-and-wait, go-back-N and selective-repeat ARQ protocols.
(b) (3p.) Explain briefly how t -error-correcting q -ary BCH codes of length n are constructed.