

## S-72.341 Coding Methods

1. (5p.) Define the following concepts:
  - (a) subgroup
  - (b) shift register
  - (c) single-error-detecting code
  - (d) accepted packet error rate
  - (e)  ~~$M$ -ary phase-shift keying (MPSK) constellation~~
2. (3p.) (Tutorial) List all possible orders taken on by the elements in the field  $GF(125)$  and determine the number of elements in the field that display each allowed order.
3. (6p.) Consider a binary code for which one bit is added to  $n - 1$  information bits to achieve even parity and length  $n$ .
  - (a) Prove that this code is linear by showing that sums of codewords are codewords.
  - (b) Give a parity check matrix and a generator matrix for this code.
  - (c) What is the minimum distance of the code? How many errors can it detect? How many errors can it correct?
  - (d) If we use odd parity instead, is the obtained code linear? Motivate.
4. (5p.) In a convolutional code, the encoder outputs the bits  $y^{(0)}, y^{(1)}, y^{(2)}$  according to the following table in going from state  $i$  to state  $j$  (state 1 is the designated initial and final state):

Old state $i$	New state $j$		
	1	2	3
1	000	111	impossible
2	impossible	010	101
3	000	impossible	111

Construct a trellis diagram and use hard-decision Viterbi decoding to find the transmitted sequence when the following sequence is received:

000 101 101 010 101 000.

5. (5p.) ~~Describe the error control parts of Compact Disc (CD) encoding and decoding. In particular, address the following issues: Why is the encoding process standard, whereas the decoding process is not standardized? Why is an interleaver involved (and what is an interleaver)?~~