

S-72.341 Coding Methods

1. (6p.) Consider the binary code $C = \{0000, 1111, 0101, 1010\}$.
 - (a) Is the code linear? Justify your answer.
 - (b) What is the code dimension? Justify your answer.
 - (c) Give a basis for the code (subspace).
 - (d) What is the error-correcting/detecting capability of the code?
 - (e) Find the dual code of C , C^\perp , and its dimension.
 - (f) Give a basis for the dual code C^\perp .
2. (6p.) (Tutorial) The generator polynomial of a cyclic binary $(7, 4)$ code is $g(x) = 1 + x + x^3$.
 - (a) Find the systematic codeword corresponding to the message word 1011.
 - (b) Sketch a diagram of the systematic encoding circuit for the code. Demonstrate how the codeword of part (a) is formed, that is, list the values of the shift register for the different phases of the encoding procedure.
3. (6p.) Define the concepts *accepted packet error rate* and *throughput*. Briefly describe the three basic retransmission protocols: stop-and-wait, go-back- N , and selective repeat. What is the difference between type-I and type-II hybrid-ARQ protocols?
4. (6p.) Construct a state diagram and a trellis diagram for the following convolutional encoder, decode the received word $(101, 100, 001, 011, 111, 101, 111, 110)$ using hard-decision Viterbi decoding, and find the original message \mathbf{x} . (The encoder starts and stops at the state $S_0 \leftrightarrow (00)$.)