

EE3101 Communication Engineering

Tutorial 10

(1) [Sklar's Problem 6.2]

Calculate the probability of message error for a 12-bit data sequence encoded with a (24, 12) linear block code. Assume that the code corrects all 1-bit and 2-bit error patterns and assume that it corrects no error patterns with more than two errors. Also, assume that the probability of a channel symbol error is 10^{-3} .

(2) [Sklar's Problem 6.3]

Consider a (127, 92) linear block code capable of triple error corrections.

(a) What is the probability of message error for an uncoded block of 92 bits if the channel symbol error probability is 10^{-3} ?

(b) What is the probability of message error when using the (127, 92) block code if the channel symbol error probability is 10^{-3} ?

(3) [Similar to Sklar's Problem 6.4]

Calculate the improvement in probability of message error relative to an uncoded transmission for a (24, 12) double-error-correcting linear block code. Assume that coherent BPSK modulation is used and that the received E_b / N_0 (uncoded) equals (a) 10dB, and (b) 4dB.

(4) [Sklar's Problem 6.8]

Consider a (7, 4) code whose generator matrix is

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

- (a) Find all the code vectors of the code.
- (b) Find $\mathbf{H}$, the parity-check matrix of the code.
- (c) Compute the syndrome for the received vector 1101101.
Is this a valid code vector?
- (d) What is the error-correcting capability of the code?
- (e) What is the error-detecting capability of the code?

(5) [Sklar's Problem 6.9]

Consider a systematic block code whose parity-check equations are

$$p_1 = m_1 + m_2 + m_4$$

$$p_2 = m_1 + m_3 + m_4$$

$$p_3 = m_1 + m_2 + m_3$$

$$p_4 = m_2 + m_3 + m_4$$

where m_i are message digits and p_i are check digits.

- (a) Find the generator matrix and the parity-check matrix for this code.
- (b) How many errors can the code correct? (Assume that d_{min} equals 4)
- (c) Is the vector 10101010 a codeword?
- (d) Is the vector 01011100 a codeword?