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328655(28)

B. E. (Sixth Semester) Examination, April-May 2021

(New Scheme)

(ET&T Engg. Branch)

INFORMATION THEORY & CODING

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Attempt all questions. Part (a) of each question is compulsory and carries 2 marks. Attempt any two parts from (b), (c) and (d) of each question and carries 7 marks.*

Unit-I

1. (a) Write the difference between lossless and lossy compression.

(b) An analog signal having 4 kHz bandwidth is sampled at 1.25 times the Nyquist rate and each sample is quantized into one of 256 equally likely levels. Assuming that the successive samples are statistically independent.

(i) What is the information rate of this source?

(ii) Can the output of this source be transmitted without error over an AWGN channel with a bandwidth of 10 kHz and S/N ratio of 20 dB?

(iii) Find the S/N ratio required for error-free transmission for part II?

(iv) Find the BW required for an AWGN channel for error free transmission of the output of this source if the S/N ratio is 20 dB.

(c) Write Lempel Ziv-Algorithm.

(d) A binary channel is having following noise characteristics :

$$\begin{bmatrix} 2/3 & 1/3 \\ 1/3 & 2/3 \end{bmatrix}$$

(i) If the input symbol are transmitted with probability 3/4 and 1/4 respt. Calculate $H(X)$, $H(Y)$, $H(X, Y)$, $H(X/Y)$ and $H(Y/X)$.

(ii) Find channel capacity, efficiency and redundancy.

Unit-II

2. (a) Define syndrome, error detection and correction capacity.

(b) Consider a (7, 4) block code with generator matrix

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

Determine whether the following received words are valid codeword

(i) 0001101

(ii) 0110101

(c) Generate a (7, 4) systematic cyclic code. Write all codes using generated matrix. Design decoding method using parity check matrix. If following code words are received, find corrected code words.

(i) 1101101

(ii) 0101000

(d) The generator polynomial for (7, 4) cyclic Hamming code is given as $G(x) = 1 + x^1 + x^3$ generated code polynomials in non systematic form for message vector $m_1 = 1010$, $m_2 = 1001$.

Unit-III

3. (a) Define primitive element and minimal polynomial.

(b) Construct the extension field GF (16) by assuming the primitive polynomial $P(y) = y^4 + y + 1$ over GF (2). Also assume the $\alpha = y$, obtain the elements of GF (16) and minimal polynomial as well.

(c) Explain decoding procedure for a single bit and multiple bit error correction BCH code.

(d) Construct the extension field GF (16) from G (4) assuming the primitive polynomial $P(y) = y^2 + y + 1$. Also obtain all the minimal polynomial.

Unit-IV

4. (a) Define code rate of convolution code.

(b) Consider convolution encoder given below has the following two generator sequences each of length 3.

$\left(g_0^{(1)}, g_1^{(1)}, g_2^{(1)}\right) = (1, 1, 1)$ and $\left(g_0^{(2)}, g_1^{(2)}, g_2^{(2)}\right) = (1, 0, 1)$

Obtain the encoder sequence for the input message.

$(m_0, m_1, m_2, m_3, m_4) = (1, 0, 0, 1, 1)$

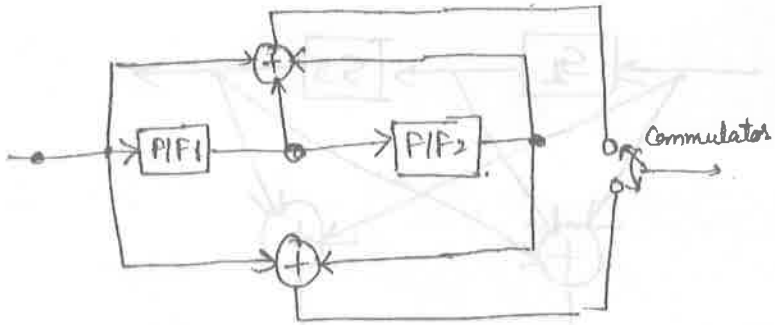


Fig : Convolution encoder

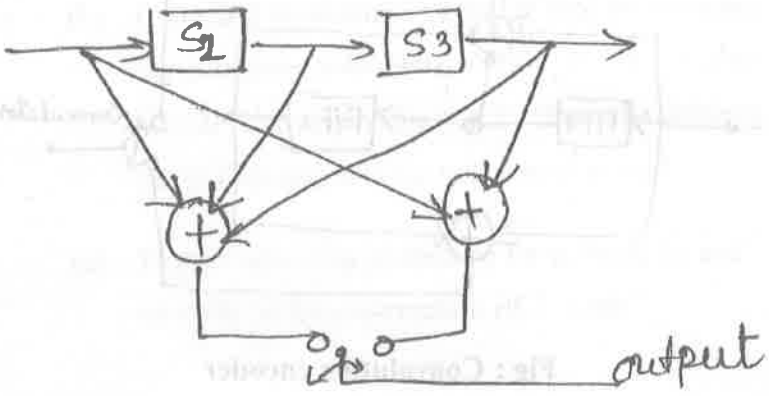
(c) Generator vectors for a rate 1/3 convolution encoder are $g_1 = (1, 0, 0)$; $g_2 = (1, 0, 1)$; $g_3 = (1, 1, 1)$

(i) Draw encoder diagram

(ii) Draw trellis diagram

(iii) Using trellis find code vector if message vector is (101100).

(d) For the encoder shown generates an all zero sequence which is sent over binary systematic channel. The received sequence 01001000.... There are two error in this sequence (2^{nd} and 5^{th}) show that this double error detection is possible with correction by application of Viterbi algorithm.



Unit-V

5. (a) Define free Eucledean Distance.

(b) Explain in details Ungerbock's TCM Design Rules, also explain TMC decoder.

(c) Explain with the help of one example how a trellis encoder can be combined with a modulator to give Trellis coded modulation.

(d) Explain the procedure of mapping by set partitioning. Why this process is done?