E&TC

College of Engineering, Pune
End Semester Exam – April 2013
Third Year B. Tech. (E & TC)
(ET 310)- (Coding Techniques in Communication Systems)

Day & Date- Friday, 26/04/2013 | Time: 2.00 – 5.00 p.m.
Maximum Marks: 50 | Duration – 3 Hrs.

Instructions:
1) All the major questions are compulsory. Regarding sub-questions follow the instructions specified at the beginning of each question.
2) Neat Diagrams must be drawn wherever necessary.
3) Assume suitable data, if necessary.
4) Figures to the right indicate full marks.

Q. 1 Attempt any FIVE sub-questions. (20)

A What is a rate distortion function (RDF)? Specify the RDF and distortion rate function (DRF) for a memory-less Gaussian source with zero mean and σ_x^2 variance.

B Consider a discrete memory-less source having three symbols in the alphabet with probabilities 0.47, 0.35 and 0.18. Draw Huffman tree for coding pair of symbols and obtain code for all possible pairs.

C Draw and explain the block diagram for generation of speech signal. List the parameters required to be set up for generation of typical speech signal.

D Specify the expression of entropy of block of 'k' random variables Y_1, Y_2,..., Y_k with joint probability $P(y_1\ y_2\ ..\ y_k)$. Obtain the upper bound of this entropy of the block.

E With respect to Viterbi convolutional decoding, explain the terms path and state metrics, decoder cells.

F How does the standard array help in determining the error correction capacity of a linear block code? Demonstrate with the help of suitable example.

G Specify the channel capacity expressions along with units for a) a discrete memory-less channel and b) band-limited AWGN channel. Determine capacity of a channel having 4 KHz bandwidth and SNR of 40 dB.

Q. 2 A Draw the tree and trellis diagrams with appropriate labels along the branches for (2, 1, 4) convolutional code with connection vectors g1 = [1 1 1 1] and g2 = [1 0 1 1]. (06)

B Determine the minimum free distance for the (2, 1, 3) convolutional code with connection vectors g1 = [1 1 1] and g2 = [1 0 1]. (04)

P.T.O.

Q. 3 A If $U(X)$ is a polynomial corresponding to a valid codeword in (n, k) cyclic code, prove that the $Rem\left[\frac{X^i . U(X)}{X^n+1}\right]$ is a polynomial corresponding to another valid codeword obtained with cyclic shift by 'i'. Here, 'Rem' denotes remainder of the division operation. (04)

B Draw the hardware logic circuit diagram for (7, 4) cyclic decoder with $g(X) = 1 + X + X^3$. Generate the tables showing a) input queue, b) shift number and c) register contents for step-wise operation on the following received polynomials. Comment on the end results. (06)

i) $Z_1(X) = 1 + X + X^3 + X^5 + X^6$

ii) $Z_2(X) = X + X^2 + X^3 + X^6$

Q. 4 A Consider a systematic block code whose parity–check equations are given below. (06)

$$p_1 = m_1 + m_3 + m_4$$
$$p_2 = m_2 + m_3 + m_4$$
$$p_3 = m_1 + m_2 + m_4$$
$$p_4 = m_1 + m_2 + m_3$$

Here, m_i are message digits and p_i are check digits.

i) Find the corresponding generator matrix.
ii) How many errors can the code correct?
iii) Are the vectors [0 1 1 0 1 0 1 0] and [0 1 0 1 1 1 0 0] codewords?

B Determine the parity – check matrix for the code specified in Q.4(A). Design and draw the hardware logic circuit diagram to detect and correct all one bit error patterns for this code. (04)

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