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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Information Theory and Coding

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data, if any, may be suitably assumed.

UNIT - I

1 a. Define: 6

i) Self Information ii) Mutual Information iii) Conditional Entropy with an example.

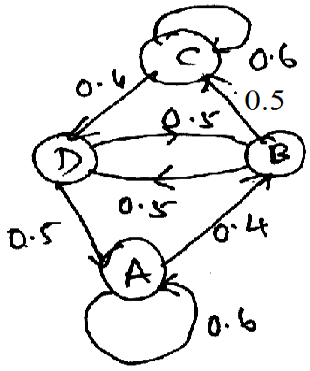
b. State and derive source coding theorem. 10

c. A discrete message source 'S' emits 2 independent symbols *x* and *y* with probabilities 0.55 and 0.45 respectively. Calculate efficiency of the source and its redundancy. 4

2 a. Discuss the various properties of entropy. 6

b. Explain JPEG standard for lossless compression. 4

c. Consider the state diagram of the Markov source of the figure. 10



i) Compute the state probabilities ii) Find the entropy of each state

iii) Find the Entropy of the source.

UNIT - II

3 a. What is a binary symmetric channel? Determine the rate of information transmission over the channel. 8

b. Generate an expression for Shannon's source coding theorem. 6

c. A binary symmetric channel has the following noise matrix with source probabilities of, 6

$$P(X_1) = \frac{2}{3} \text{ and } P(X_2) = \frac{1}{3}$$

$$P\left(\frac{Y}{X}\right) = \begin{matrix} X_1 \\ X_2 \end{matrix} \begin{bmatrix} 3/4 & 1/4 \\ 1/4 & 3/4 \end{bmatrix}$$

$$\quad Y_1 \quad Y_2$$

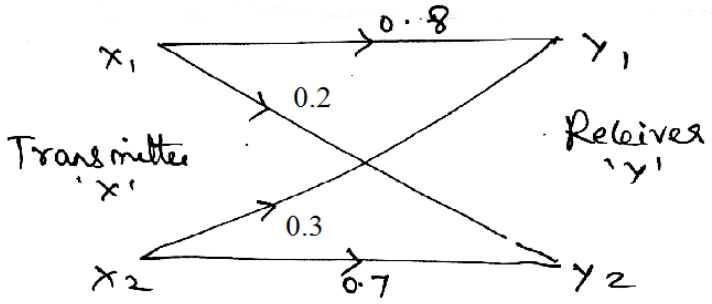
Contd….2

i) Determine; $H(X)$, $H(Y)$, $H(X,Y)$, $H(Y,X)$, $H\left(X/Y\right)$ and $I(X,Y)$

ii) Find the channel capacity C

iii) Find channel efficiency of redundancy.

4 a. Find the mutual information and the channel capacity of the channel shown in the figure. Given $P(X_1) = 0.6$ and $P(X_2) = 0.4$. 8



b. A message source produce two independent symbols A and B with probabilities P(A) = 0.3 and P(B) = 0.7. Calculate the efficiency of the source and hence its redundancy. If symbols received in average with 5 in every 100 symbols are error, calculate the Transmission rate of a system. 12

UNIT - III

5 a. Explain with matrix Description of Linear Block Codes. 8

b. Define the following:

i) Black codes ii) Random Error

iii) Hamming Weight iv) Convolution code. 4

c. Consider a (6, 3) linear code whose generator matrix is,

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

8

i) Find all code vectors

ii) Find all the Hamming Weight and distances

iii) Find minimum weight parity check matrix

iv) Draw the encoder circuit for the above codes.

6 a. What is a field? List all the properties of fields. 6

b. What is error control coding? Give the basic idea of error correcting codes and the objectives of a good error control coding scheme. 6

c. Discuss the types of errors in error control schemes. 8

Contd….3

UNIT - IV

7 a. Explain the following:

i) Burst errors correction code ii) Shortened cyclic code 10

iii) Golay Code iv) Fire codes.

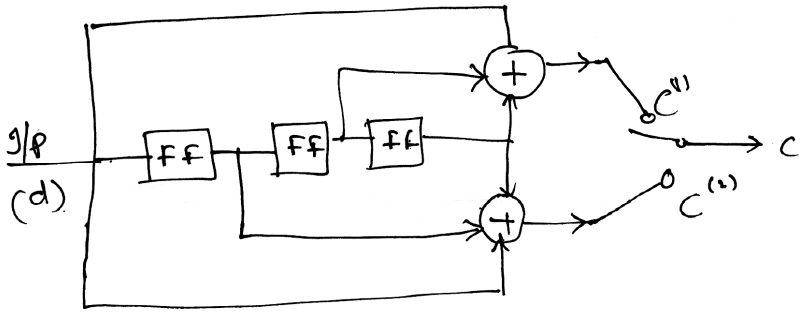
b. In a (7, 4) Binary cyclic the generator polynomial is given by $g(x) = 1 + x + x^3$. Find the code word for the messages (1001) and (1011). Show the contents of registers at each step. Also point out corresponding Systematic and Non-systematic cyclic code word. 10

8 a. Consider a (15, 11) cyclic code generated by $g(x) = 1 + x + x^4$. Devise a feedback shift register encodes circuits. Illustrate the encoding procedure with the message vector 0010110111 by listing the state of the registers. 10

b. Explain the properties of cyclic codes. 10

UNIT - V

9 a. Figure shows a (2, 1, 3) convolution encodes.



10

i) Draw the state diagram ii) Draw a code tree.

b. Explain encoding of convolutional codes using time domain approach with an example. 10

10 a. What do you understand by trellis diagram of a convolutional encoder? Explain clearly. 10

b. Consider the (3, 1, 2) convolutional code with $g^{(1)} = (110)$, $g^{(2)} = (101)$ and $g^{(3)} = (111)$

i) Draw the encoder block diagram

ii) Find the generator matrix 10

iii) Find the code-word corresponding to the information sequence (1 1 1 0 1) using time domain Transform domain approach.

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