5E1351

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5E1351

B. Tech. V - Sem. (Main / Back) Exam., March - 2022

ESC Computer Science & Engineering

5CS3 – 01 Information Theory & Coding

Time: 2 Hours

Maximum Marks: 80

Min. Passing Marks: 28

Instructions to Candidates:

Attempt all five questions from Part A, four questions out of six questions from Part B and two questions out of three from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[5×2=10]**

All questions are compulsory

Q.1 Prove the following statement, "if the receiver knows the message being transmitted, the amount of information carried is zero."

Q.2 State the Shannon's first theorem for source coding.

Q.3 What is the value of syndrome vector for error free transmission?

Q.4 Define the basic properties Galois fields.

Q.5 What do you mean by surviving path of Viterbi decoding?

PART – B

(Analytical/Problem solving questions) **[4×10=40]**

Attempt any four questions

Q.1 Prove that the upper boundary on entropy is given as $H_{Max} \leq \log_2 M$ here 'M' is the number of message emitted by the source.

Q.2 Channel capacity is given by –

$$C = B \log_2 \left(1 + \frac{S}{N}\right) \text{ bits/sec}$$

In the above equation when the signal power is fixed and white Gaussian noise is present, the channel capacity approaches an upper limit with increase in bandwidth 'B'. Prove that this upper limit is given as -

$$C_\infty = \lim_{B \to \infty} C = 1.44 \frac{S}{NO} = \frac{1}{\ln^2} \frac{S}{NO}$$

Q.3 For a systematic ∠BC, the three parity check digits C_4, C_5 and C_6 are given by-

$$C_4 = D_1 + D_2 + D_3$$

$$C_5 = D_1 + D_2$$

$$C_6 = D_1 + D_3$$

(i) Construct generator matrix

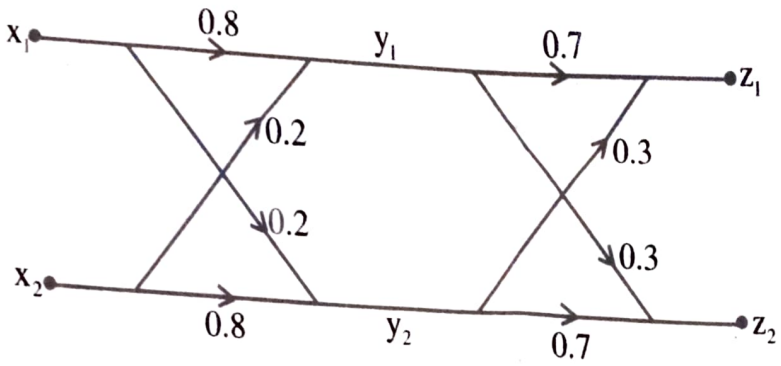
(ii) Construct code generated by this matrix

Determine error correcting capability.

Q.4 The generator polynomial of a(7, 4) cyclic code is G(p) = p3 + p + 1. Find all the code vectors and generator matrix for the code systematic form of cyclic code.

Q.5 Explain the Viterbi decoding or maximum likelihood decoding with an example.

Q.6 The BSC are connected in cascade as shown in fig -



- Determine the transition matrix for discrete memory less channel.
- Determine $P(z_1)$ and $P(z_2)$ if $p(x_1) = 0.6$ and $p(x_2) = 0.4$.

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) **[2×15=30]**

Attempt any two questions

Q.1 For a discrete memory less source 'x' with six symbols $x_1, x_2 \ldots\ldots\ldots x_6$. Find a compact code for every symbol if the probability distribution is as follows -

$P(x_1) = 0.3$ $P(x_2) = 0.25$ $P(x_3) = 0.2$

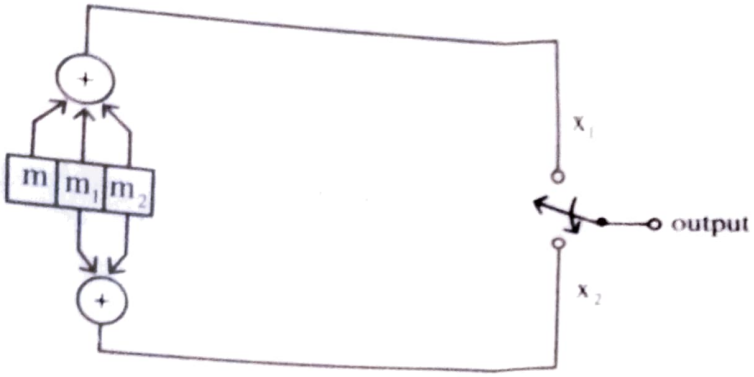
$P(x_4) = 0.12$ $P(x_5) = 0.08$ $P(x_6) = 0.05$

Q.2 For a systematic linear block encoder, the generator matrix is given by -

$$\left[\begin{array}{ccccccc} 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \end{array}\right]$$

- Decode the received words 101100 and if it is incorrect then recover correct code word.

Q.3 For the convolution encoder with constraint length of 3 and rate $\frac{1}{2}$ as shown below -



Find out -

(i) Code rate (1)

(ii) Dimension of encoder (1)

(iii) Constraint length (1)

(iv) Generating sequence (1)

(v) Output sequence for message sequence of m = (10011)
