

7. (a) Explain the concept of Maximum Likelihood Decoding.
- (b) For a Reed Solomon code symbol size is of 2 bits and number of errors that can be corrected is 1 ($t = 1$). Find
- RS code length
 - Parity check bits size
 - Message length
 - Code rate

$$6 + (1.5 \times 4) = 12$$

Group - E

8. (a) What is the idea behind Trellis-coded modulation? How does it achieve error-performance improvements without increasing signal bandwidth?
- (b) Explain how the trellis code is optimized by maximizing the free Euclidean distance.
9. (a) What is Low Density Parity Check Code? Mention some of its practical applications.
- (b) Explain BJCR decoding algorithm in brief.

$$(2 + 4) + 6 = 12$$

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ERROR CONTROL AND CODING (ECEN 5202)

Time Allotted: 3 hrs

Full Marks: 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and Any 5 (five) from Group B to E, taking at least one from each group. Candidates are required to give answer in their own words as far as practicable.

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1=10**
- For a noiseless channel, $I(X;Y)$ is

(a) $H(X) - H(Y)$	(b) $H(Y) - H(X)$
(c) $H(X)$	(d) $H(X) - H(Y/X)$.
 - Entropy represents

(a) amount of information	(b) rate of information
(c) measure of uncertainty	(d) probability of message.
 - A (7, 4) LBC with minimum distance 3 guarantees error detection of

(a) ≤ 4 bits	(b) ≤ 2 bits
(c) ≤ 3 bits	(d) \leq None of theses.
 - To design an error correcting LBC with 11 bits of message block the minimum number of bits in the codewords should be

(a) 15	(b) 11	(c) 12	(d) 16.
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 - The Hamming distance between $v = 1100001111$ and $w = 1001101001$ is

(a) 1	(b) 5	(c) 3	(d) 4.
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 - A discreet memoryless source entropy H and average word length L have the following boundary condition

(a) $L \geq H$	(b) $L < H$
(c) $L \geq e^H$	(d) $L < H^2$.

- (vii) BCH code is a subclass of
 - (a) cyclic code
 - (b) turbo code
 - (c) Reed Solomon code
 - (d) Hadamard code.
- (viii) Memoryless channels are called
 - (a) burst error channels
 - (b) random error channels
 - (c) combined error channels
 - (d) none of these.
- (ix) Common decoding technique for convolution code word is
 - (a) Syndrome decoding
 - (b) Hamming decoding
 - (c) Viterbi decoding
 - (d) Huffman decoding.
- (x) The mutual information of a channel with independent input and output is
 - (a) Zero
 - (b) constant
 - (c) variable
 - (d) infinite.

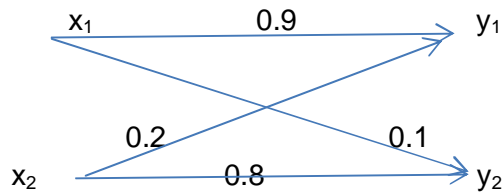
Group - B

2.(a) Determine the Shannon Fano code for the following messages with their probabilities given below:

x_1	x_2	x_3	x_4	x_5	x_6	x_7
0.05	0.15	0.2	0.05	0.15	0.3	0.1

Calculate the efficiency and entropy of the code.

- (b) Given a binary channel as shown in the below figure
 - (i) Find the channel matrix of the channel
 - (ii) Find $P(y_1)$ and $P(y_2)$ when $P(x_1) = P(x_2) = 0.5$
 - (iii) Find the joint probabilities $P(x_1, y_2)$ and $P(x_2, y_1)$ when $P(x_1) = P(x_2) = 0.5$



6 + 6 = 12

- 3.(a) What is Galois field? Construct the Galois field GF(24) generated by $p(x) = x^4 + x + 1$ and show the binary representation of elements (consider upto 16 elements).
- (b) Define primitive element. Explain clearly the terms Primitive polynomial and Irreducible polynomial. Under which condition an irreducible polynomial becomes primitive?

(2 + 4) + (1 + 3 + 2) = 12

Group - C

- 4.(a) Explain with reference to Block coding the following terms
 - (i) Generator matrix
 - (ii) Syndrome
 - (iii) Parity check matrix
- (b) In a repeated (n, k) block code a binary 0 and a binary 1 is encoded as a sequence of (2t + 1) digits . Find the generator matrix and the parity check matrix with t = 1. Find H and find the value of GH^T .

(3 × 2) + 6 = 12

- 5.(a) Write a short note on shortened cyclic code and burst error correcting codes.
- (b) What is meant by minimal polynomial? Determine the generator polynomial of a single error correcting BCH code where block length is 15.

(3 + 3) + (2 + 4) = 12

Group - D

- 6.(a) Giving block diagram, explain the operation of any convolution encoder
- (b) Explain the Viterbi algorithm for decoding convolution code.

6 + 6 = 12