

Total No. of Questions :8]

P2580

SEAT No. :

[Total No. of Pages :4

[5153] - 556

**T.E. (Electronics & Telecommunication Engineering)**  
**INFORMATION THEORY AND CODING TECHNIQUES**  
**(2012 Course) (Semester - II) (304189) (End Sem.)**

Time : 2½ Hours]

[Max. Marks :70

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Figure to the right side indicate full marks.
- 3) Use of calculator is allowed.
- 4) Assume suitable data if necessary.

- Q1) a) The joint probability matrix representing transmitter and receiver is given below. Find all entropies and mutual information of the communication system [6]

$$P(X,Y) = \begin{bmatrix} 0.3 & 0.05 & 0 \\ 0 & 0.25 & 0 \\ 0 & 0.15 & 0.05 \\ 0 & 0.05 & 0.15 \end{bmatrix}$$

- b) Obtain the coding efficiency of a Shannon Fano for a zero memory sources that emits eight messages with respective probabilities as given below. Use 3 letters for encoding such as -1, 0, 1. [6]

$$P = [0.3 \quad 0.12 \quad 0.12 \quad 0.12 \quad 0.12 \quad 0.08 \quad 0.07 \quad 0.07]$$

$$X = [x_1 \quad x_2 \quad x_3 \quad x_4 \quad x_5 \quad x_6 \quad x_7 \quad x_8]$$

- c) Explain the case study related to application of Huffman's coding and JPEG in image compression. [8]

OR

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Q2) a) The Parity check matrix of a (7, 4) Hamming Code is given as below: [7]

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

- i) Find Generator Matrix.
  - ii) Find out all possible codewords.
  - iii) Determine error correcting capability of the code.
- b) Consider (7, 4) cyclic code: with  $g(x) = x^3 + x + 1$ . [7]
- i) Draw the hardware arrangement of cyclic encoder and verify the encoder by considering one message.
  - ii) If received code vector is 1001101, find out transmitted or corrected codeword.
- c) Explain any two properties of mutual information and show that Shannon's limit for AWGN Channel is -1.6dB. [6]

Q3) a) Find generator polynomial for BCH code over GF(16) using primitive polynomial  $P(x) = x^2 + x + 2$  over GF(4) codeword. The code should correct  $t_c = 1, 2$  errors. The addition and multiplication tables are as given below: [8]

+	0	1	2	3
0	0	1	2	3
1	1	0	3	2
2	2	3	0	1
3	3	2	1	0

•	0	1	2	3
0	0	0	0	0
1	0	1	2	3
2	0	2	3	1
3	0	3	1	2

- b) Write short notes on [6]
- i) CRC codes
  - ii) Golay Codes
- c) Explain FEC technique for Error Control. [4]

OR

- Q4)** a) Explain the steps of BCH decoding with Goreinsein Zierler Algorithm. [6]  
 b) Explain the applications of RS codes and CRC code. [6]  
 c) Distinguish between BCH and RS codes. [6]

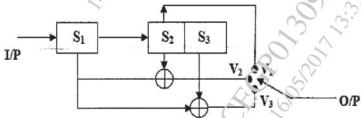
**Q5)** a) Explain the following: [12]

- i) Code Rate
- ii) Constraint Length
- iii) Word Length
- iv) Block Length
- v) Free Distance
- vi) Hamming Distance

b) What are Turbo Codes? Explain the coding and decoding of Turbo codes. [4]

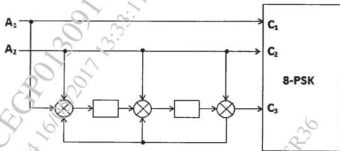
OR

**Q6)** a) For the convolution encoder shown in fig below, construct the Code tree and trellis diagram, find out the out of the encoder corresponding to message sequence 10110 using trellis. [10]



b) Explain Sequential decoding and Viterbi decoding. [6]

- Q7) a) What are the Ungerboeck's TCM design rules. Explain asymptotic coding gain. [6]
- b) Consider the 8 state, 8 PSK TCM scheme as shown below. [10]



- i) Draw trellis diagram
- ii) Find  $d_{\text{free}}$  and Asymptotic coding gain and comment on it.

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- Q8) a) Discuss Mapping by Set partitioning. [6]
- b) Explain Euclidean distance, Asymptotic coding gain of trellis coded Modulation. [4]
- c) Draw and explain the band limited and power limited coding system. [6]

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