

[5253] -156

**T.E. (Electronics and Telecommunication Engineering)**  
**Information Theory and Coding Techniques**  
**(2012 Pattern) (Semester - II)**

*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 and Q.7 or Q.8.
- 2) Figures to the right indicate full marks.
- 3) Use of calculator is allowed.
- 4) Assume suitable data if necessary.

**Q1)** a) A discrete memory less source having channel matrix  $= \begin{bmatrix} 0.6 & 0.4 \\ 0.3 & 0.7 \end{bmatrix}$ , emits equiprobable messages  $X_1$  &  $X_2$ . Draw Channel diagram and hence, find  $H(X)$ ,  $H(Y)$ ,  $H(X,Y)$ ,  $H(X/Y)$ ,  $I(X;Y)$  [7]

b) Design coding and decoding technique for (5,1) linear block code. Write all valid code words, find error correcting and detecting capability of this code. Find corrected code words for following received codes. [8]

i) 10100

ii) 11101

c) Prove that mutual information is given by

$$I(X; Y) = H(X) + H(Y) - H(X, Y) . \quad [5]$$

OR

**Q2)** a) Obtain the coding efficiency of a Shannon Fano and Huffman code for a zero memory source that emits seven messages (E, N, G, L, H, S, I) with probabilities of {0.2, 0.15, 0.02, 0.1, 0.4, 0.08, 0.05} respectively. [8]

b) Explain hamming bound for perfect code and hence, comment whether following code is perfect code or not, with necessary justification. [7]

i) (7, 4) LBC

ii) (6, 3) LBC

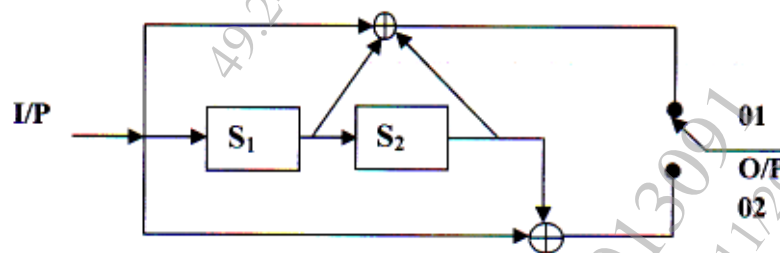
c) Explain JPEG image compression standard. [5]

**P.T.O.**

- Q3) a)** Use  $x^4 + x + 1$  as primitive polynomial and Find [7]
- All elements of  $GF(2^4)$
  - Cyclotomic decomposition,
  - Coset leaders,
  - Corresponding minimal polynomials
- b) Consider the BCH (15, 5) triple error correcting code has the following generator polynomial  $g(x) = x^{10} + x^8 + x^5 + x^4 + x^2 + x + 1$ . Find the errors using Gorenstein – Zierler algorithm in received polynomial  $x^{13} + x^{10} + x^8 + x^4 + x + 1$  [7]
- c) Explain Selective repeat ARQ. [4]

OR

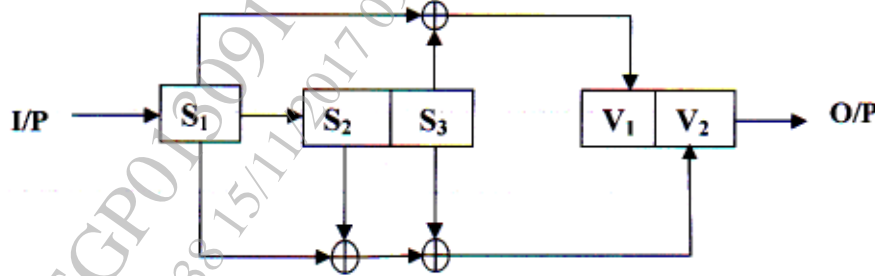
- Q4) a)** Determine the generator polynomial of double error correcting BCH code with a block length 15. Use the primitive polynomial  $x^4 + x + 1$ . What is minimum distance of this code. [10]
- b) Draw Syndrome generator circuit for (7,4) cyclic code generated using  $g(x) = 1 + x + x^3$ . Calculate syndrome for receiver vector [0110100] [8]
- Q5) a)** A convolution encoder has code rate =  $\frac{1}{2}$  constraint length  $K = 3$  as shown in Figure below. Draw the trellis diagram. By using Viterbi algorithm decode the sequence 010001000. [8]



- b) Explain following code [8]
- Fire code
  - Golay Code
  - CRC - code
  - Interleaved Code

OR

- Q6)** a) For the convolution encoder shown in figure below. Sketch the state diagrams, Code Tree and trellis diagram. Find the output data sequence 10011. [10]



- b) Explain Low Density Parity Check code. [6]

- Q7)** a) What are the Ungerboeck's TCM design rules. [4]  
 b) Write Shannon Hartley Capacity Theorem. [4]  
 c) What is bandwidth efficiency plane? Explain different regions in the plane. [8]

OR

- Q8)** a) Explain how coding gain is improved in TCM. [8]  
 b) What are the goals of communication system designer? Explain any three of them. [8]

