Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Remedial Examination April 2010

Subject code: 710402 Subject Name: Information Theory & Coding

Date: 07 / 04 / 2010 Time: 12.00 noon – 02.30 pm

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** An error control code has the following parity check matrix **06**

$$H = \begin{bmatrix} 1\,0\,1\,1\,0\,0 \\ 1\,1\,0\,0\,1\,0 \\ 0\,1\,1\,0\,0\,1 \end{bmatrix}$$

(i) Determine the generator matrix G
(ii) Find the code word that begin with 101…
(iii) Decode the received code word 110110.
Comment on error detection capability of this code.

(b) Explain construction of instantaneous code and state the theorem of kraft inequality. **06**

Q.2 **(a)** Construct the Shannon–Fano code for the probability distribution (0.5, 0.25, 0.125, 0.125). Given distribution is dyadic. Draw the CDF and $\overline{F}(x)$ for the given distribution function. If Distribution is non dyadic, What is the difference to construct Shannon–Fano code for dyadic distribution and non dyadic distribution. **06**

(b) The source alphabet A,B,C,D,E,F if A appears twice as often as E and F twice as often as any constant. **06**

(a) Find a binary Huffman code with various orderings scheme.
(b) Find ternary Huffman code.
(c) Write a concluding remarks on binary and ternary Huffman code.

OR

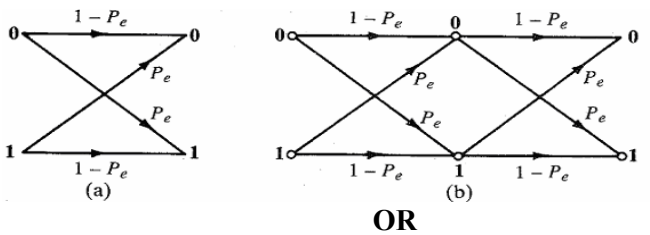
(b) Consider a telegraph source having two symbols dot and dash. The dot duration is 0.2 sec and the dash duration is 3 times of the dot duration. The probability of the dot's occurring is twice that of dash and time between symbols is 0.2 seconds. Calculate information rate of telegraph source. **06**

Q.3 **(a)** State and explain theorem of extensions of source with proof. **06**

(b) Consider the binary symmetric channel shown in fig.. The channel matrix is given by **06**

$$M = \begin{bmatrix} 1\text{-pe} & \text{pe} \\ \text{pe} & 1\text{-pe} \end{bmatrix}$$

and below figures shows a cascade of two such BSCs



OR

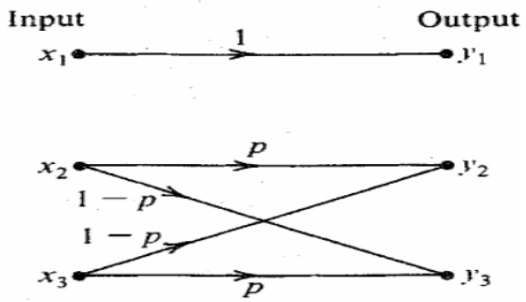
Q.3 **(a)** The ternary channel shown figure $P_x(x1)=P$, $P_x(x2)= P_x (x3)= Q$ (Note : P+2Q =1) **06**

(i) Determine H(x), H(x|y),H(y) and I(x;y)

(ii) Show that the channel capacity Cs is given by

$$Cs = \log\left(\frac{\beta+2}{\beta}\right)$$

Where $\beta=2^{-[plogp+(1-p)log(1-p)]}$



(b) Prove $0 \leq H(x) \leq \log_2 M$. Here M is the number of messages emitted by the source. (Hint : - ln x ≤ x-1 for x ≥ 0) **06**

Q.4 **(a)** Define following terms: **06**

(i) Golay codes

(ii) BCH codes

(iii) RS codes

(b) Why are cyclic codes effective in detecting error burst? The message 1001001010 is to be transmitted in a cyclic code with a generator polynomial $g(x)=x^2+1$. **06**

(i) How many check bits does the encoded message contain?

(ii) Obtain the transmitted code word?

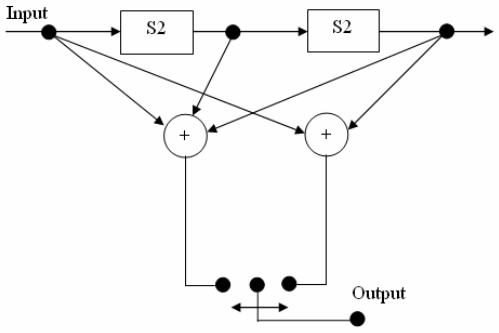
(iii) Draw encoding arrangement to obtain remainder bits.

OR

Q.4 **(a)** The generator polynomial of (15,11) Hamming code is given by $g(x)=1+x+x^4$, Develop encoder and syndrome calculator for this code using systematic form. **06**

(b) Write a note on cyclic codes also mention advantages and disadvantages. **06**

Q.5 **(a)** The given encoder generates an all zero sequence which is sent over a binary symmetric channel. The received sequence 01001000… . There are two errors in this sequence (at second and fifth position). Show that this double error detection is possible with correction using viterbi algorithms. **06**

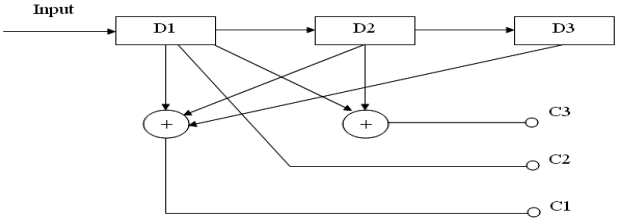


(b) Describe Data Encryption Standard scheme. **06**

OR

Q.5 **(a)** Describe any one decoding techniques for the binary double error correcting BCH codes. **06**

(b) For the given convolution encoder develop the encoder states and the code tree. **06**



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