

GUJARAT TECHNOLOGICAL UNIVERSITY**M.E –IIst SEMESTER–EXAMINATION – JULY- 2012****Subject code: 1724103****Date: 10/07/2012****Subject Name: Error Control Coding In Communication****Time: 10:30 am – 13:00 pm****Total Marks: 70****Instructions:**

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

Q.1 (a) (i) If C is a valid code vector, then prove that $CH^T=0$ where H^T is the transpose of the parity check matrix H . **04**

(ii) Prove that all 2^k n -tuples of a coset have the same syndrome and the syndromes for different cosets are different. **03**

(b) Consider a systematic block code whose parity- matrix is **07**

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

- (i) Find the generator matrix and parity-check matrix for this code.
- (ii) How many errors can the code detect and correct?
- (iii) Is the vector 10101010 a codeword?
- (iv) Draw the corresponding syndrome calculation circuit.

Q.2 (a) (i) Explain maximum likelihood decoding for error control coding **04**

(ii) Prove that Let $g(x) = g_0 + g_1x + \dots + g_{r-1}x^{r-1} + x^r$ be the nonzero code polynomial of minimum degree in (n, k) cyclic code C . then, the constant term g_0 must be equal to 1. **03**

(b) A $(15,5)$ linear cyclic code has a generator polynomial **07**

$$g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$$

- (i) Draw the block diagram of an encoder for this code.
- (ii) Find the code polynomial for the message polynomial $D(x) = 1 + x^2 + x^4$ in systematic form by listing the state of the registers.
- (iii) Is $v(x) = 1 + x^4 + x^6 + x^8 + x^{14}$ a code polynomial?

OR

(b) Consider a $(15,11)$ cyclic code generated by $g(x) = 1 + x + x^4$. Devise a feedback shift register encoder circuit. Illustrate the encoding procedure with the message vector 10010110111 by listing the state of the registers and Draw the syndrome calculation circuit. **07**

Q.3 (a) (i) Bring out advantages of cyclic code over linear block code **03**

(ii) Consider a $(127,92)$ linear block code capable of triple error corrections **04**

- I. What is the probability of message error for an uncoded block of 92 bits if the channel symbol error probability is 10^{-3} ?
- II. What is the probability of message error when using the $(127,92)$ block code if the channel symbol error probability of 10^{-3} ?

(b) The $(7,4)$ cyclic code is generated by $g(x) = 1 + x^2 + x^3$. Find the syndrome of the received message vector $r(x) = x + x^3 + x^5$ by listing the state of the registers. Is it a code vector? If no, then correct using Meggitt decoder circuit. **07**

OR

Q.3 (a) Draw the general block diagram of Meggitt decoder circuit and explain its operation **07**

(b) Consider the $(3,1,2)$ convolutional code with $g^{(1)} = (110)$, $g^{(2)} = (101)$ and $g^{(3)} = (111)$. **07**

- (i) Draw the encoder block diagram.
- (ii) Find the generator matrix
- (iii) Find the code-word corresponding to the information sequence (11101) using time-domain and transform domain approach.

- Q.4 (a)** Explain encoding of convolution codes using time domain approach with an example. **07**
(b) Consider the convolution encoder shown in figure1.the code is systematic. **07**

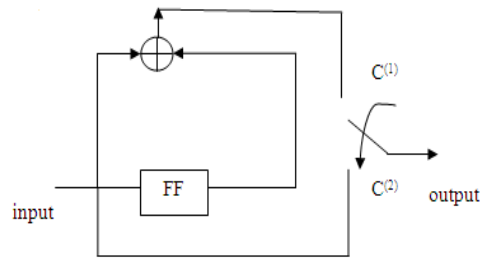


Figure 1

- (i) Draw the state diagram
(ii) Draw the code tree.
(iii) Find the encoder output produced by the message sequence 10111.
(iv) Verify the output using time-domain approach.

OR

- Q.4 (a)** What are RS codes? How are they formed? **07**
Q.4 (b) For the convolutional encoder shown in figure 2. **07**

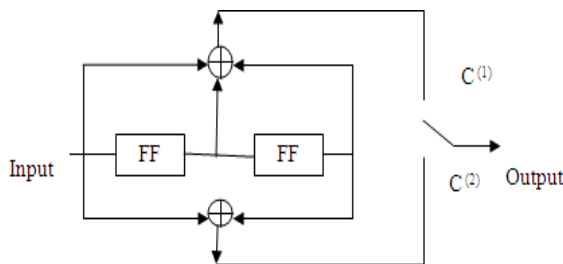


Figure 2

- (i) Draw the state and trellis diagrams and determine the output digit sequence for the data digits 10111.
(ii) Use viterbi's algorithm to decode the received sequence: 1001011000 and find the message.

- Q.5 (a)** Explain MAP algorithm. **07**
(b) (i) write a short note on interleaved codes **03**

- (ii) Figure 3 shows a turbo encoder. The message bit sequence to encode is $m=1\ 0\ 1\ 1\ 0\ 1\ 0\ 0$ with leftmost bit entering the encoder first. The bit position change by the interleaver is shown in figure. Find out encoded output sequence. **04**

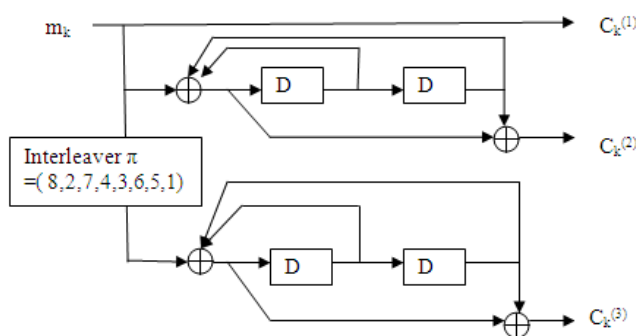


Figure 3

OR

- Q.5 (a)** Explain EG-LDPC code. **07**
(b) For $m=3$, there exists a $(7,4)$ code generated by $g(x)=1+x+x^3$. Suppose that it is shortened by one digit. **07**
(i) Draw the block diagram of an encoder
(ii) Draw the block diagram of a decoder
(iii) Is the vector 101010 a codeword? If no, the correct it.
