Seat No.: ________ Enrolment No.______________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2014

Subject code: 1724103 **Date: 04-12-2014**

Subject Name: Error Control Coding Communication

Time: 02:30 pm - 05:00 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)** For an (n, k) linear code C with minimum distance d_{min}, prove that all the n-tuples of weight of $t = (d_{min}-1)/2$ or less can be used as coset leaders of a standard array of C. If all the n-tuple of weight t or less are used as coset leader, prove that there is at least one n-tuple of weight t + 1 that cannot be used as a coset leader. **07**

(b) Repetition codes represent simplest type of linear block codes. The generator matrix of a (5,1) repetition code is given by **07**
[G]=[1 1 1 1 | 1]
(1) Write its parity check matrix.
(2) Evaluate the syndrome for all five possible single error patterns and also for all ten possible double error patterns.

Q.2 **(a)** The parity check bits of a (8,4) block code are generated by **07**
$C_5=d_1+d_2+d_4$
$C_6=d_1+d_2+d_3$
$C_7=d_1+d_3+d_4$
$C_8=d_2+d_3+d_4$
Where d_1, d_2, d_3 and d_4 are message bits.
(1) Find the generator matrix and parity check matrix for this code.
(2) Find minimum weight of this code.
(3) Show that it is capable of correcting all single error patterns and capable of detecting all double errors by preparing the syndrome table for them.

(b) Prove that, If $g(x) = g_0+g_1x+$é $..+g_{r-1}x^{r-1}+x^r$ be the nonzero code polynomial of minimum degree in (n, k) cyclic code C. then, prove that the constant term g_0 must be equal to 1. **07**

OR

(b) Prove that, If g(x) is a polynomial of degree n-k and is a factor of X^n+1, then g(X) generates an (n,k) cyclic code. **07**

Q.3 **(a)** Explain operation of Meggitt decoder for decoding of cyclic codes. **07**

(b) For a (7,4) cyclic code, the received vector is 0100101 and the generator polynomial is $g(x)=1+x+x^3$. Draw the syndrome calculation circuit and correct the error in received vector if present. **07**

OR

Q.3 **(a)** What are the advantages of cyclic codes over linear block codes? Discuss various properties of cyclic codes. **07**

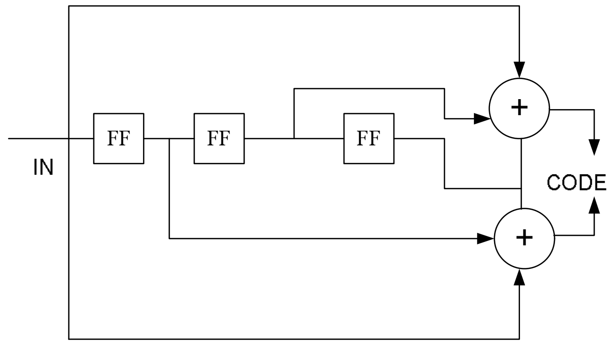
(b) The (7,4) cyclic code is generated by $g(x) = 1+x^2+x^3$. Find the syndrome of the received message vector $r(x)= x + x^3+x^5$ by listing the state of the registers. Is it a code vector? If no, then correct using Meggitt decoder circuit **07**

Q.4 **(a)** For a (2,1,3) convolutional encoder shown below **07**

(1) Draw state diagram.

(2) Draw code Tree.

(3) Find the encoder output produced by the message sequence 11001 by traversing through the code tree.



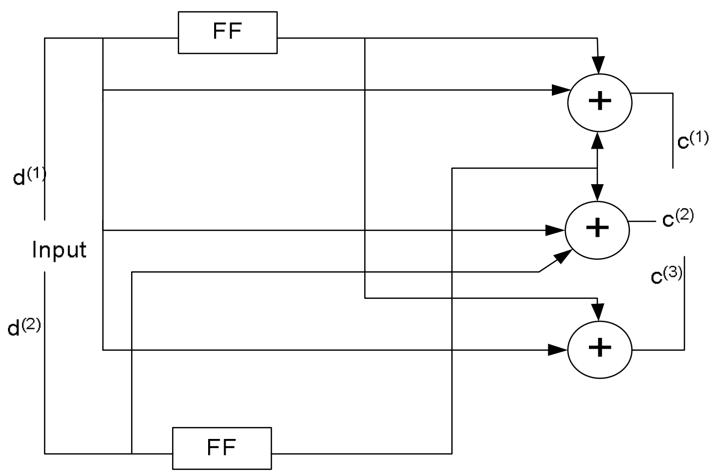
(b) Explain cyclic code decoding using Viterbi Decoder. **07**

OR

Q.4 **(a)** For a (3,2,1) encoder shown below find code word C for input sequence of $d^{(1)}$=101 and $d^{(2)}$=110 using **07**

(1) Time domain approach

(2) Transform domain approach



(b) Given that the codewords c1(x) and c2(x) belonging to the double error correcting (15,7) code constructed over $GF(2^4)$, incur 2 and 1 errors so giving **07**

(a) $V_1(x)= x^{11}+x^9+x^8+x^6+x^5+x+1$

(b) $V_2(x)=x^{12}+x^{11}+x^{10}+x^9+x^7+x^5+x$

respectively, determine $c_1(x)$ and $c_2(x)$.

Q.5 **(a)** Explain MAP decoding algorithm. **07**

(b) Write short note on PG-LDPC codes. **07**

OR

Q.5 **(a)** Write down general steps for decoding of RS codes. Also write down some of the applications of RS codes. **07**

(b) Write down short note on Maximum Likelihood Decoding. **07**

****