Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (ECE)/SEM-2/MCE-202/2013

2013

ERROR CONTROL CODING

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer Question No. **1** and any *four* from the rest.

GROUP – A

1. Answer any *seven* questions : $7 \times 2 = 14$

   a) Explain the properties of group with an example.

   b) For a GF (5) with elements { 0, 1, 2, 3, 4 } give the modulo 5 addition table

   c) What are the irreducible polynomial ? Explain the condition when these are considered as primitive polynomials.

   d) State the properties of linear block code.

   e) What is the error correcting and detecting capability of an (n, k) linear block code.

   f) Explain maximum likelihood decoding technique.

g) Determine the conjugates of α^2 in $GF\left(2^3\right)$ and $GF\left(2^4\right)$.

h) What is the probability of an undetected error in linear block codes over BSC.

i) Compute :

I. $\alpha^2 + \alpha$ in $GF\left(2^3\right)$

II. $\alpha^5 + \alpha + 1$ in $GF\left(2^3\right)$.

GROUP – B

Answer any *four* of the following. $4 \times 14 = 56$

2. Define linear block codes. State the properties. For the linear block code (7, 4) has a generator matrix as given below.

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

a) Explain the error correcting and detecting capability.

b) Draw the encoding circuit for the (7, 4) systematic code and determine the codeword for message u = 1011.

c) Explain syndrome detection in linear block code and give the syndrome detection circuit for the above code.

2 + 3 + 5 + 4

3. For a (3, 1, 2) convolution code with $g^{(1)} = (1 \quad 0 \quad 1)$ and $g^{(2)} = (1 \quad 1 \quad 1)$ $g^{(3)} = (1 \quad 0 \quad 0)$

   a) Determine the code word for message u = (1001)

   b) Give the hardware realization of the encoder

   c) Give the state diagram for the encoder

   d) Using viterbi decoding technique decode the received code word r = 101010010000. 2 + 4 + 4 + 4

4. Define BCH codes. Determine the minimal polynomial of the elements of the $GF(2^4)$. Determine the generator polynomial for (15, 7) BCH code which is able to correct error pattern of size t = 2 or less. Determine the parity check matrix. 4 + 4 + 6

5. Explain cyclic codes and their properties. Given a (7, 4) cyclic code with $g(x) = x^4 + x^2 + x + 1$.

   a) Determine the systematic and non-systematic codeword polynomial for the information polynomial $i(x) = x^2 + x + 1$.

   b) What is a Meggitt decoder. Design the Meggitt decoder for the above cyclic code and give the detailed operation. 7 + 7

6. Explain the error correcting single error correcting and double error correcting technique of BCH code.

   Give the code word $c(x)$ belong to a double error correcting $(15, 7)$ code constructed over $GF\left(2^4\right)$ incurs 2 errors so giving the received code $v(x) = x^{11} + x^9 + x^8 + x^6 + x^5 + x + 1$. Find out the codeword $c(x)$.

7. Write short notes on the following : 5 + 5 + 4

   a) Reed Solomon codes

   b) Syndrome detection

   c) Standard array.