



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

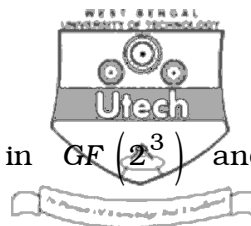
The figures in the margin indicate full marks.

*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 $GF(2^3)$ and $GF(2^4)$.
- h) What is the probability of an undetected error in linear block codes over BSC.
- i) Compute :
- I. $\alpha^2 + \alpha$ in $GF(2^3)$
 - II. $\alpha^5 + \alpha + 1$ in $GF(2^3)$.

GROUP – B

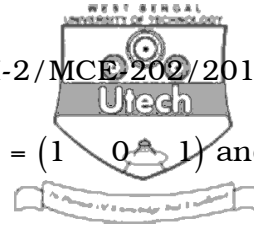
Answer any *four* of the following. $4 \times 14 = 56$

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 $g^{(1)} = (1 \ 0 \ 1)$ and $g^{(2)} = (1 \ 1 \ 1)$ $g^{(3)} = (1 \ 0 \ 0)$

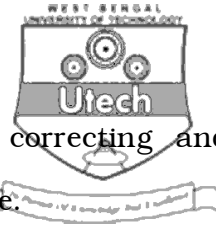
- Determine the code word for message $u = (1001)$
- Give the hardware realization of the encoder
- Give the state diagram for the encoder
- Using viterbi decoding technique decode the received code word $r = 101010010000$. 2 + 4 + 4 + 4

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 $g(x) = x^4 + x^2 + x + 1$.

- Determine the systematic and non-systematic codeword polynomial for the information polynomial $i(x) = x^2 + x + 1$.
- 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 $GF(2^4)$ 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.
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