



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(IT)/SEM-7/IT-703E/2012-13

2012

INFORMATION THEORY AND 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.*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $5 \times 2 = 10$
 - i) The minimum and maximum values of source entropy of a source X having m number of symbols are
 - a) 0 and $\log_2 m$
 - b) 1 and $\frac{1}{m}$
 - c) 0 and m
 - d) $\log_2 m$ and 0.
 - ii) The source entropy for a binary source X generating independent symbols 0 and 1 with equal probabilities is
 - a) 2 bits/symbol
 - b) 1 bit/symbol
 - c) 4 bits/symbol
 - d) none of these.
 - iii) Golay code is a
 - a) BCH code
 - b) Linear code
 - c) Convolutional code
 - d) Cyclic code.
 - iv) The coset leader of the code $C = \{ 0000, 1011, 1110 \}$ is
 - a) 0010
 - b) 1001
 - c) 1100
 - d) 0111.



- v) Two linear q -array codes are called equivalent if one can be obtained from the other by one or both of the operations listed below
- (i) Multiplication of the components by a non-zero scalar
 - (ii) Permutation of the position of the codeword.
- a) only (i) b) only (ii)
c) both (i) and (ii) d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is mutual information for the events X and Y ? When does mutual information become self information ?
3. State and explain in brief source coding theorem.
4. Discuss the Huffman coding procedure for constructing binary optimal.
5. Explain a channel model in brief. What is Binary symmetric Channel ?
6. What are the necessary condition for a code C to be cyclic ? Give an example.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) State and prove Shannon's Channel Capacity theorem.
- b) Find amount of information produced by each source with probability x, y, z with probability $\frac{1}{5}, \frac{1}{2}$ and $\frac{1}{3}$.



- c) A discrete memory less source has an alphabet of five symbols with there are given by,

$$[X] = [X_1, X_2, X_3, X_4, X_5]$$

$$[P] = [0.45, 0.15, 0.15, 0.10, 0.15]$$

Compute entropy and second order extension for the symbol. Find the amount of information gained by observing the source.

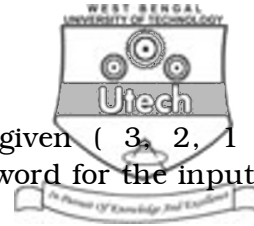
8. a) Explain the following :

- (i) Singleton Bound
- (ii) Nearest neighbourhood Decoding
- (iii) Syndrome
- (iv) Hamming code
- (v) Code Rate.

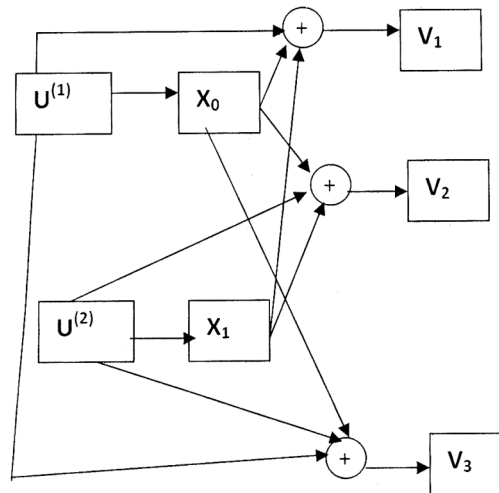
- b) Show that $C = \{0000, 1100, 0011, 1111\}$ is a linear code. What is its minimum distance ?

- c) Find an expression for the probability of decoding error in block code with transition probability p . Hence calculate its value for a $(6, 3)$ code given that the weight distribution of its coset leaders is

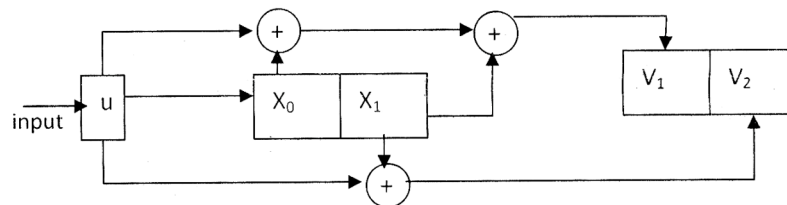
$$\alpha_0 = 1, \alpha_1 = 6, \alpha_2 = 3, \alpha_3 = 5, \alpha_4 = \alpha_5 = \alpha_6 = 0$$



9. a) Find the generator matrix of the given (3, 2, 1) convolutional encoder. Find the codeword for the inputs $u(1) = (110)$ and $u(2) = (011)$



- b) Find the state table, state diagram, code tree and trellis diagram of the following convolutional encoder.



10. Write short notes on the following :

- Generation of a BCH code
- Decoding of a BCH code
- Error detecting and correcting capabilities of a block code.