



Name :

Roll No. :

Invigilator's Signature :

**CS/B.Tech (IT)/SEM-7/IT-703E/2011-12
2011**

INFORMATION THEORY & 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 :

$$10 \times 1 = 10$$

i) The entropy for a discrete source is a maximum when the output symbols are probable.

- a) reciprocally b) jointly
- c) mutually d) equally.

ii) Kraft Inequality is represented by which of the following expressions ?

- a) $\sum_{k=1}^L 2^{-n_k} \leq 1$ b) $\sum_{k=1}^L 2^{-n_k} = 1$
- c) $\sum_{k=1}^L 2^{-n_k} \geq 1$ d) $\sum_{k=1}^L 2^{-n_k} \equiv 1.$



iii) The example of VLC is

- a) Huffman coding
- b) Arithmetic coding
- c) Lempel-Ziv coding
- d) All of these.

iv) In a code $C = \{ 0100, 1111 \}$ which consists of two codewords 0100 and 1111. Then, the Hamming distance between the two codewords would be

- a) 1
- b) 2
- c) 3
- d) 4.

v) Two linear q -ary 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.

vi) To transmit information over noisy channel, which of the following condition must be satisfied ?

- a) $\frac{H(X)}{T_s} \leq \frac{C}{T_c}$
- b) $\frac{C}{T_c} \leq \frac{H(X)}{T_s}$
- c) $\frac{C}{T_c} < \frac{H(X)}{T_s}$
- d) $\frac{C}{T_c} > \frac{H(X)}{T_s}$.



vii) Golay code is a

- a) Linear code
- b) Cyclic code
- c) BCH code
- d) Convolutional code.

viii) How many bits are required to encode (FLC) the letters of the English alphabet ?

- a) 3
- b) 4
- c) 5
- d) 6.

ix) The coset leader of the code $C = \{ 0000, 1011, 1110 \}$ is

- a) 0010
- b) 1001
- c) 0111
- d) 1100.

x) The code rate of any coding scheme is always

- a) less than unity
- b) greater than unity
- c) equal to unity
- d) none of these.



GROUP - B

(Short Answer Type Questions)

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

2. a) Discuss the interrelationship between Uncertainty and Information.
- b) Find self-information of a binary source that emits a sequence of statistically independent symbols. The output is either a 0 with probability p or a 1 with a probability $1-p$.
3. What is the need of entropy ? A DMS with source probabilities $\{ 0.30, 0.25, 0.20, 0.15, 0.10 \}$, then what will be its entropy ?
4. Explain in the following :
 - a) Singleton Bound
 - b) Nearest neighbourhood decoding
 - c) Syndrome
 - d) Hamming code
 - e) Code rate.



5. What do you mean by convolutional code ? What is a primitive polynomial ? What do you mean by the systematic structure of a linear block code ?
6. Explain the principle of operation of Meggitt Decoder.

GROUP - C

(Long Answer Type Questions)

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

7. a) Write applications of linear block code. 3
- b) Consider the following generator matrix over $G\Gamma(2)$

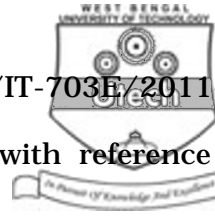
$$G = \begin{bmatrix} 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{bmatrix}$$

- i) Generate all possible codewords using this matrix.
- ii) Find the parity check matrix, H .
- iii) What is the minimum distance of this code ? 9
- c) Describe the differences between linear block code and BCH code. 3



8. a) What are the differences between Cyclic code and Linear block code ? How does cyclic code express by Generator Polynomial expression ? 7
- b) How does a convolutional code represent by a set of polynomial expressions ? Explain with examples. 5
- c) What is the importance of Galois field in Linear block coding ? 3
9. a) Describe Binary Symmetric Channel (BSC) and Discrete Memoryless Channel (DMC) with the help of diagrams. 5
- b) Describe the encoding and decoding techniques for Huffman code. What are the limitations of Huffman code ? 5
- c) Consider a discrete binary source that emits a sequence of statistically independent symbols. The output is either a 0 with probability p or a 1 with probability $1-p$. Show the entropy of this binary source is

$$H(X) = -p \log_2(p) - (1-p) \log_2(1-p) \quad 5$$



10. a) Explain the measure of information with reference to probability of occurrence of an event. 5
- b) What is entropy of an information source ? Find an expression for the same. 3 + 7
11. Write short note on Binary Symmetric Channel and Standard Array. 7 + 8

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