BTDSE311N

B.Tech. / B.Tech. + M.B.A. / B.Tech. + M.Tech. (CSE-ICS, CSE-BDAI, CSE-CMCI, CSE-DSI, CSE-FSDI, IT)

III Semester Examination, Dec.23-Jan.24

Information Theory and Coding

Choice Based Credit System (CBCS)

Time: 3 Hrs.

Maximum Marks: 60

Minimum Pass Marks: 24

Note: (1) All questions carry equal marks, out of which part 'A' and 'B' carry 3 marks and part 'C' carries 6 marks.
(2) From each question, part 'A' and 'B' are compulsory and part 'C' has internal choice.
(3) Draw neat diagram, wherever necessary.
(4) Assume suitable data wherever necessary.

03

Q.1(A) Define entropy and rate of information.

(B) A source emits four symbols with probabilities 0.4, 0.3, 0.2, 0.1. Find out the entropy of the source. 03

(C) Prove that entropy is maximum when all the messages are having equal probabilities. 06

OR

Find all the entropies associated with a communication system whose joint probability matrix is shown below:

$$p(x,y) = \begin{pmatrix} 0.3 & 0 & 0.2 \\ 0 & 0.25 & 0 \\ 0 & 0.15 & 0.1 \end{pmatrix}$$

Q.2(A) What is mutual information? 03

(B) State and explain shannon's theorem. 03

(C) An information source produces a sequence of independent symbols with probabilities $\frac{1}{3}$, $\frac{1}{27}, \frac{1}{9}, \frac{1}{3}, \frac{1}{27}, \frac{1}{9}, \frac{1}{27}$. Find the coding efficiency using Huffman code for M=2. 06

OR

Explain noise free channel and binary symmetric channel.

Q.3(A) With example explain single bit and burst error. 03

(B) Compare systematic and non-systematic code. 03

(C) Define differential entropy. Also find the differential entropy for the following function: 06

$$f(x) = \frac{1}{b-a} \qquad a \leq x \leq b$$

OR

Construct a generator matrix whose parity bits are given by

$P_{11} = P_{12} = P_{21} = P_{22} = P_{31} = P_{13} = P_{33} = 1$ and $P_{23} = P_{33} = 0$

Find all the codewords. Also determine its error controlling capability.

Q.4(A) State linearity and cyclic property of cyclic code. **03**

(B) Explain in short BCH code and shortened cyclic code. **03**

(C) A (15,5) cyclic code has a generator polynomial **06**

$G(p) = p^{10} + p^8 + p^5 + p^4 + p^2 + p + 1.$

Calculate the codes for the data bits 01011, 10011, 11011.

OR

Find (7,4) systematic cyclic code for the data sequence.

(i) 0110   (ii) 1001   (iii) 1101

If the generator polynomial is $1 + p + p^3$.

03
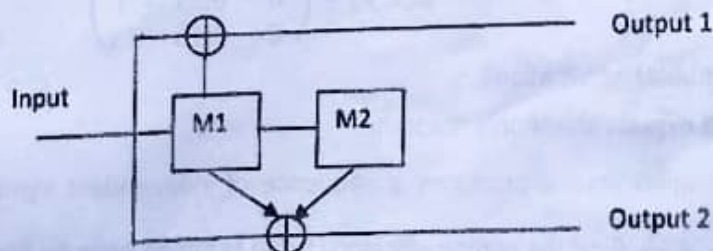
Q.5(A) Define:

(i) Constraint Length

(ii) Code Rate

(iii) Dimension of Code **03**

(B) Explain Viterbi Decoding. **06**

(C) Compare block code and convolutional code.

OR

Determine the output sequence for the message sequence 11001 for the following convolutional encoder:

XXXXXXX

Unit -5 ⇒ Time domain, transfer domain
Symmetric, non-symmetric

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Q.1(A) What is Entropy? Derive the formula for Entropy. 03

(B) Prove that Entropy is maximum when all the messages are having equal probabilities. 03

(C) Define Independent and Dependent sources. Also Explain Markoff Statistical Model. 06

OR

Find Mutual Information associated with a communication system whose joint probability matrix is shown below:

$$p(x, y) = \begin{bmatrix} 0.2 & 0.1 & 0.2 \\ 0 & 0.2 & 0.05 \\ 0 & 0.15 & 0.1 \end{bmatrix}$$

Q.2(A) State and explain Shannon Hartley theorem 03

(B) What is a Binary Symmetric Channel? 03

(C) An information source produces a sequence of independent symbols with probabilities 0.4, 0.04, 0.08, 0.2, 0.12, 0.08, 0.08. Find the coding efficiency using Huffman code for M=2. 06

OR

Explain Binary Erasure Channel and find its channel capacity.

Q.3(A) With an example explain single bit and burst error. 03

(B) Calculate 7-bits Hamming Code for following data bits 1010 and 1101. 03

(C) Find the constant C so that the following given function is a probability density function. Also find its differential entropy. 06

$$f(x) = C(2x + 3) \quad 1 < x < 3$$

OR

For a systematic linear block code, the three parity bits are given by

$$C_4 = d1 \oplus d2 \oplus d3$$
$$C_5 = d1 \oplus d3$$
$$C_6 = d1 \oplus d2$$

Construct generator matrix and find all the codes. Also determine its error controlling capability.

Q.4(A) State linearity and cyclic property of cyclic code.   03

(B) Compare Systematic and Nonsystematic codes.   03

(C) Explain in short BCH, RS and Shortened Cyclic Codes.

<div align="center">OR</div>

Find (7,4) Systematic and Non-Systematic Cyclic Code for the data sequence:

(i) 0111   (ii) 1001   (iii) 1111

If the generator polynomial is $1 + p^2 + p^3$.

Q.5(A) Define

(i) Constraint Length   (ii) Code Rate   (iii) Dimension of Code   03

(B) Explain the decoding technique of convolutional code.   03

(C) Compare block code and convolutional code.   06

<div align="center">OR</div>

Calculate the Convolutional Code using transform domain approach for the input sequence 11011 and 10110 if the generating sequences are $g^1 = \{1\ 0\ 1\}$ and $g^2 = \{1\ 1\ 1\}$.

<div align="center">**XXXXXXXXX**</div>