Printed Pages : 3 Roll No. NEC408



**B.TECH.**

**THEORY EXAMINATION (SEM–IV) 2016-17**

**INFORMATION THEORY AND CODING**

***Time : 3 Hours*** ***Max. Marks : 100***

***Note :*** *Be precise in your answer. In case of numerical problem assume data wherever not provided.*

## SECTION – A

**1. Explain the following:** **10 x 2 = 20**

**(a)** Draw the block diagram of communication system

**(b)** At what condition entropy attains maximum value? Write the expression for source efficiency

**(c)** Out of following code which one is non singular?

| **Source** | **$S_1$** | **$S_2$** | **$S_3$** | **$S_4$** |
|---|---|---|---|---|
| **Code A** | 00 | 001 | 101 | 110 |
| **Code B** | 00 | 100 | 111 | 00 |

**(d)** List out two important properties of mutual information

**(e)** State Shannon Hartley Theorem with expression.

**(f)** List out the properties of Block codes.

**(g)** Find the hamming weight of two code vectors $C_1$=0001010, C2=1010101

**(h)** What are convolutional codes? How is it different from block codes?

**(i)** Obtain an Expression for zero memory information sources emitting independent sequence of symbols

**(j)** Why (23, 12) Golay code is called Perfect code?

## SECTION – B

**2. Attempt any five of the following questions:** **5 x 10 = 50**

**(a)** (i) A source emits one of the four possible messages $S_1$, $S_2$, $S_3$ and $S_4$ with probabilities 4/11, 3/11, 2/11 and 2/11 respectively. Find the entropy of the source. List all the elements for the second extension of the source. Hence show that H ($S^2$) =2 H(S).

(ii) Discuss the properties of Entropy

**(b)** (i) Discuss External Property of Entropy with examples

(ii) Explain the need for source coding in communication system and discuss about compact code

**(c)** (i) Consider the following S={$X_1$, X2, X3, X4, X5, X6**}** with probability P= {0.4, 0.2, 0.2, 0.1, 0.08, 0.02}.Find the code words using Shannon fano Algorithm and efficiency of source

(ii) Clearly explain differential entropy of continuous signal. How it is different from entropy of discrete signals?

**(d)** (i) Explain the properties of Mutual information.

(ii) For a Systematic (7, 4) linear block code, the parity matrix P is given by

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

(A) Find all possible code vectors

(B) A single error has occurred in received vector. Detect and correct the error **R**=[1011100]

**(e)** (i) Discuss the data compression techniques

(ii) Consider the (4,3,2)code with input sequence $u^1$=(101), $u^2$=(110) and $u^3$=(011).The corresponding input polynomials are $u^{(1)}(D)= 1+D^2$, $u^{(2)}(D)=1+D$. construct the codeword using transform domain approach.

**(f)** (i) A transmitter has symbol consisting of five letters $\{a_1, a_2, a_3, a_4, a_5\}$ and receiver as a symbol of four letters $\{b_1, b_2, b_3, b_4\}$.The joint probabilities of the system are given as

$$P(A, B) = \begin{bmatrix} 0.25 & 0 & 0 & 0 \\ 0.10 & 0.30 & 0 & 0 \\ 0 & 0.05 & 0.10 & 0 \\ 0 & 0 & 0.05 & 0.1 \\ 0 & 0 & 0.05 & 0 \end{bmatrix}$$

Compute H (A), H (B), H (A, B) and I(A,B).

(ii) Discuss about (i) priori entropy (ii) Posteriori Entropy (iii) Equivocation

**(g)** (i) Explain uniquely decodable code and optimal code.

(ii) An information source produces sequences of independent symbols having the following probabilities. Construct ternary code using Huffman coding procedure and find it efficiency.

| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 1/3 | 1/27 | 1/3 | 1/9 | 1/9 | 1/27 | 1/27 |

**(h)** (i) Explain the Concept of Shortened Cyclic codes and Burst error correcting codes

(ii) A source produces sequence of symbols having the following probabilities.

| A | B | C | D | E |
|---|---|---|---|---|
| 0.25 | 0.25 | 0.2 | 0.15 | 0.15 |

Construct binary code using Shannon fano Elias coding procedure and find its Length and efficiency.

## SECTION – C

**Attempt any two of the following questions:** **2 x 15 = 30**

**3.** **(a)** A Binary Symmetric Channel has following matrix with Source probabilities $P(X_1) = 2/3$, $P(X_2) = 1/3$. Determine H(X), H(Y), H(Y/X) and Chanel capacity

$$P\left(\frac{Y}{X}\right) = \begin{pmatrix} \frac{3}{4} & \frac{1}{4} \\ \frac{1}{4} & \frac{3}{4} \end{pmatrix}$$

**(b)** Consider the four codes listed below. Identify the instantaneous codes using Kraft Mcmilan inequality theorem

| **Source symbol** | **Code A** | **Code B** | **Code C** | **Code D** |
|---|---|---|---|---|
| $S_1$ | 0 | 0 | 0 | 0 |
| $S_2$ | 100 | 10 | 100 | 10 |
| $S_3$ | 110 | 110 | 110 | 110 |
| $S_4$ | 111 | 11 | 11 | 111 |

**4.** **(a)** **Write a Short note On:**

(i) BCH codes and RS codes (ii) Golay codes

(iii) Burst and Random Error correcting codes

**(b)** A (6, 3) Linear block code has following check bit $C4=d_1+d_2$, $C_5=d_1+d_3$, $C_6=d_2+d_3$

(i) Write G and H Matrices. (ii) construct standard array table.


**5.** **(a)** Discuss about hamming distance and minimum distance with good examples.

**(b)** Consider the (3,1,2) convolution codes with $g^{(1)}$=(110), $g^{(2)}$=(101) and $g^{(3)}$=(111)

(i) Draw the encoder diagram and find the generator matrix

(ii) Find the codeword corresponding to the information sequence (11101) using time domain approach.