GANPAT UNIVERSITY
B. Tech. Semester: VII (EC)
CBCS Regular Examination December 2013
2EC701 INFORMATION THEORY AND CODING

Time: 3 Hours **Total Marks: 70**

Instruction:

1. All questions are compulsory.
2. Write answer of each section in separate answer books.
3. Figures to the right indicate marks of questions.
4. Standard terms and notations are used.

SECTION I

Q-1 (A) Write the Shannon's theorem and discuss the tradeoff between bandwidth efficiency and power efficiency. [06]

(B) A binary discrete memory source produces symbols with probabilities 0.1, 0.2, 0.15, 0.09, 0.20, 0.26. Design a Huffman code for the above source. Find the coding efficiency of your code. [06]

OR

Q-1 (A) A binary memory less source produces the binary symbols 0 and 1 with probabilities p and (1-p) respectively. Determine the entropy for the source and sketch the variation of the entropy with the value of p. [04]

(B) Determine the channel capacity for a binary symmetric channel having following channel matrix and equal input symbol probability. Conditional probabilities are: $P(Y_1|X_1) = 0.5$, $P(Y_2|X_1) = 0.5$, $P(Y_1|X_2) = 0.5$, $P(Y_2|X_2) = 0.5$. [08]

Q-2 (A) Consider a (7,4) Hamming code whose generator matrix is G. [06]

1. Find the code vectors for following data vectors: 1010, 1111, 1100, 1000
2. Find the parity check matrix **H**.
3. Detect valid codeword for received vector 1111110 by syndrome decoding method.

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

(B) Write notes on detection and correction of linear block codes using *standard array* decoding. [05]

OR

Q-2 (A) Draw and explain block diagram of digital communication and give the difference between the *source coding* and *channel coding*. [05]

(B) Using suitable example explain Nonsingular, Uniquely Decodable and prefix free codes. [06]

Q-3 (A) Consider the following $(k+1, k)$ systematic linear block code with the parity check digit c_{k+1} given by [06]

$$c_{k+1} = d_1 + d_2 + \cdots + d_k$$

1. Construct the appropriate generator matrix for this code.
2. Construct the code generated by this matrix for $k = 3$.
3. Determine the error detection and correction capabilities of this code.

(B) Consider a (7, 4) cyclic code whose generator polynomial is $g(x) = x^3 + x^2 + 1$. Find out systematic and non-systematic codewords for data vector: 1011, 1001, 0010. [06]

SECTION II

Q-4 Explain Trellis coded modulation and draw the trellis diagram for rate 2/3 convolution encoder as shown in figure 1. [12]

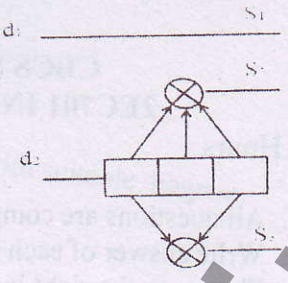

Figure 1

OR

Q-4 For the convolution encoder shown in figure 2 draw the state, trellis and tree diagrams and determine the output sequence for data digits 11011 [12]

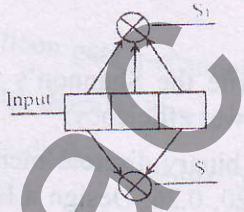

Figure 2

Q-5 Consider the primitive polynomial $p(z) = z^3 + z + 1$ over $GF(2)$. Construct the extension field $GF(8)$ and take $\alpha = z$ be the primitive element. Find elements of $GF(8)$ as power of α and the corresponding minimal polynomial and give the generator polynomial for single error correcting and double error correcting BCH code. [11]

OR

Q-5 (A) Derive the equation of hamming bound. Check whether (15, 11) and (15, 5) linear block codes are perfect codes or not. [06]

(B) Write short note on Viterbee decoding. [05]

Q-6 (A) Write a short note on turbo coding. [06]

(B) Prove that for any (n, k) cyclic code generator polynomial $g(x)$ must be one of the prime(irreducible) factor of $x^n + 1$ [06]

END OF PAPER