Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(ECE)/SEM-7/EC-703/2012-13

2012
CODING AND INFORMATION THEORY

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 alte natives for any *ten* of the following : $10 \times 1 = 10$

   i) A code with minimum distance $d_{mm} = 3$. How many errors it can correct ?

   a) 3 b) 2

   c) 1 d) 0.

   ii) The generator polynomial of a cyclic code is factor of

   a) $X^n + 1$ b) $X^{(n+1)} + 1$

   c) $X^{(n+2)} + 1$ d) $X^{(n-1)} + 1$.

iii) Entropy means

a) amount of information

b) rate of information

c) measure of uncertainty

d) probability of message.

iv) The Hamming distance between (1001011, 0100010) is

a) 3 b) 4

c) 2 d) 1.

v) The capacity of a communication hannel with a bandwidth of 4 kHz and 15 SNR is approx

a) 20 kbps b) 16 kbps

c) 10 kbps d) 8 kbps.

vi) A message that is sent in cryptography is known as

a) plaintext b) ciphertext

c) encryption d) decryption.

vii) A (7, 4 cyclic code is generated by a generator polynomial of degree

a) 3 b) 4

c) 2 d) 5.

viii) An encoder for a (4, 3, 2) convolution code has a memory order of

a) 3 b) 4

c) 2 d) 1.

ix) Which of the following expressions is incorrect ?

a) $H(y/x) = H(x, y) - H(x)$

b) $I(x, y) = H(x) - H(y/x)$

c) $H(x, y) = H(x, y) + H(y)$

d) $I(x, y) = H(y) - H(y/x)$

x) The ideal communication channel is defined for a system which has

a) Finite C b) $BW = 0$

c) $S / N = 0$ d) Infinite C.

xi) The length of the key used in DES is

a) 128 bits b) 64 bits

c) 32 bits d) 96 bits.

GROUP – B

(Short Answer Type Questions)

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

2. Explain why a error correcting code must at least satisfy Hamming Bound. What is Hamming code ? 4 + 1

3. In a repeated code a binary 0 and a binary 1 is encoded as a sequence of $(2t + 1)$ digits. Find the generator matrix and the parity check matrix for a repeated code with $t = 1$.

1 + 3 + 1

4. Explain the concept of Maximum Likelihood decoding.

5. Design a generator matrix for a (7, 4) LBC code.

6. Discuss the advantages and disadvantages of convolutional codes.

GROUP – C

(Long Answer Type Questions)

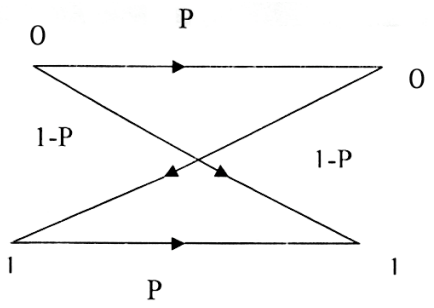
Answer any *three* of the following. 3 × 15 = 45

7. a) Find the entropy of a source generating *n* number of messages having different probability of occurrence.

   b) State and explain Source coding theorem.

   c) An analog signal band limited to 10 kHz is quantized in 8 levels of a PCM system with probability 1/4, 1/5, 1/5, 1/10, 1/10, 1/20, 1/20, 1/20 respectively. Calculate entropy and the rate of information. 5 + 5 + 5

8. For a BSC shown below find the channel capacity for $P = 0{\cdot}9$. Derive the formula that you have used. 5 + 10



9. The parity check bits of a (8, 4) block code are generated by

$C_5 = d_1 \oplus d_2 \oplus d_4$, $C_6 = d_1 \oplus d_2 \oplus d_3$

$C_7 = d_1 \oplus d_3 \oplus d_4$, $C_8 = d_2 \oplus d_3 \oplus d_4$

a) Find the generator matrix and the parity check matrix of this code.

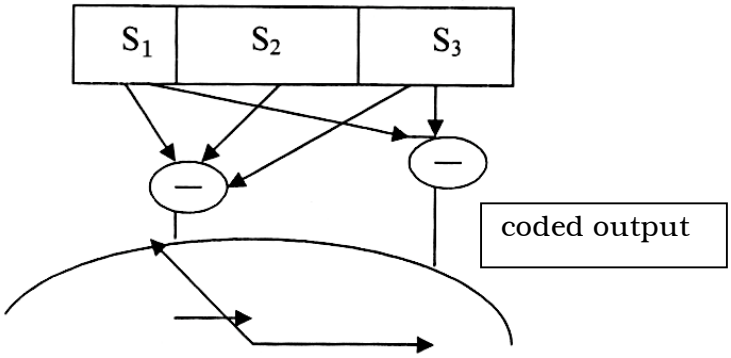
b) Find the minimum weight of this code

c) Why is Huffman code called optimum code ? A DMS has five symbols x_1, x_2, x_3, x_4, x_5 with $p(x_1) = 0 \cdot 4, p(x_2) = 0 \cdot 19$, $p(x_3) = 0 \cdot 16, p(x_4) = 0 \cdot 15$, $p(x_5) = 0 \cdot 1$. Construct a Shanon Fano code and calculate the code efficiency. 6 + 4 + 4 + 1

10. a) Construct a decoding table for the (7, 4) cyclic code for the error pattern e = 1000000, e = 0100000, e = 0001000. Assume $g(x) = x^3 + x^2 + 1$. Determine the data vector corresponding to the received vector r = 1101101. 6 + 4

b) Consider $g(x) = x^3 + x + 1$. Design an encoding circuit for (7, 4) cyclic code and determine the output for the code 1011. 3 + 2

11. For the convolutional encoder shown below suppose the first six received digits are 010001. Using Viterbi's algorithm and Trellis diagram explain the process of decoding.



12. Explain with examples DES and RSA algorithms. 7 + 8

13. Write short notes on any *three* of the following : 3 × 5

a) Error control strategies

b) Standard array

c) Spanning of generator matrix in cyclic code

d) shortened cyclic code.

14. A (15, 5) linear cyclic code has a generator polynomial has

$g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$

a) Draw the block diagram of the encoder for this code. 3

b) Find the code polynomial for the message polynomial $d(x) = 1 + x^2 + x^4$ (in a systematic form). 5

c) Is $v(x) = 1 + x^4 + x^6 + x^8 + x^{14}$ a code polynomial ? If not, find the syndrome of $v(x)$. 2

d) A (7, 4) linear cyclic code has a generator polynomial $g(x) = 1 + x + x^3$. Draw the syndrome circuit and find out the syndrome showing all the contents of the registers in all the required shifts for r = 0010110. 5