Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS / B.TECH (ECE-NEW) / SEM-7 / EC-703 / 2010-11

2010-11

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

i) For $GF(2^3)$ the elements in the set are

a) { 1, 2, 3, 4, 5, 6, 7 }

b) { 0, 1, 2, 3, 4, 5, 6 }

c) { 0, 1, 2, 3 }

d) { 0, 1, 2, 3, 4, 5, 6, 7 }.

ii) If $m = 4$ then what will be the length of BCH code ?

a) 16 b) 15

c) 17 d) None of these.

iii) The binary Hamming Codes have the property that

a) $(n,k) = (2^m + 1,\ 2^m - 1 - m)$

b) $(n,k) = (2^m - 1,\ 2^m - 1 + m)$

c) $(n,k) = (2^m - 1,\ 2^m - 1 - m)$

d) $(n,k) = (2^{m-1},\ 2^m - 1 - m)$.

iv) The encoder for a (4, 3, 2) convolution code has a memory order of

a) 4 b) 3

c) 2 d) 1.

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

a) Finite C b) BW = 0

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

vi) The no. of shift registers in a (2, 1, 2) convolution encoder is

a) 2 b) 1

c) 3 d) 0.

vii) The length of the key used in DES is

a) 128 bits b) 64 bits

c) 32 bits d) 96 bits.

viii) Chein search is used for decoding

a) Linear Block codes b) BCH codes

c) Convolution codes d) None of these.

ix) Cyclic Redundancy Check is a type of

a) Convolution code b) Cyclic code

c) Parity check code d) None of these.

x) Hamming codes are

a) single error correcting codes

b) double error correcting codes

c) Burst error correcting codes

d) Triple error correcting codes.

xi) 1 nat is equal to

a) 3·32 b) 1·32

c) 1·44 d) 3·44.

xii) The condition of a dual code in case of linear block code is

a) $GH^T = 0$ b) $(HG)^T = 0$

c) $H^T G^T = 0$ d) $GH^T = 1$.

GROUP – B

(Short Answer Type Questions)

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

2. a) What do you mean by Cyclic Burst ? 1½

   b) For (15, 10) cyclic code, given D = 1010001101, P = 110101. Calculate FCS & the error in the received word, where the symbols have their usual meanings. 3½

3. a) Compare ARQ & FEC schemes of Error control strategies. 2

   b) The generator matrix for a (7, 4) block code is given :

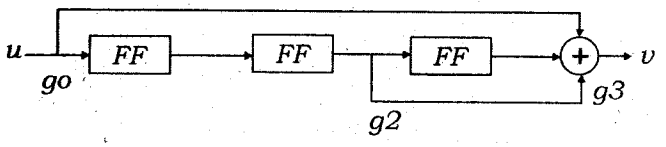
$$G = \begin{vmatrix} 1000101 \\ 0100111 \\ 0010110 \\ 0001011 \end{vmatrix}$$

   i) Find the Parity check matrix of this code.

   ii) If the received code word is [0 0 0 1 1 1 0], then find the transmitted code word. $2 \times 1½$

4. Calculate the throughput efficiency of the stop and wait ARQ system. 5

5. Consider the convolution encoder shown below :



$g0 = 1$, $g1 = 0$, $g2 = 1$, $g3 = 1$, Determine the output sequence given for the given input sequence $u = (1001)$ using impulse domain method.

6. Define block cipher. What do you mean by ciphertext ? 2 + 3

GROUP – C

(Long Answer Type Questions)

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

7. a) What is standard array ? Explain how the standard array can be used to make a correct decoding. 2 + 3

b) Consider the (7, 4) linear block code whose decoding table is given below :

Syndrome	Coset leader
100	1000000
010	0100000
001	0010000
110	0001000
011	0000100
111	0000010
101	0000001

Show with an example that this code can correct any single error but makes a decoding error when two or more errors occur. 6

c) Show that if the minimum distance of a t-error correcting code is d_{min}, then $t \leq (d_{min} - 1)/2$. 4

8. Let the polynomial $g(X) = x^{10} + x^8 + x^5 + x^4 + x^2 + x + 1$ be the generator polynomial of cyclic code over *GF* (2) with block length 15.

a) Find the parity-check matrix H.

b) How many errors can this code detect ?

c) How many errors can this code correct ?

d) Write the generator matrix in the systematic form.

e) Find the generator polynomial of its dual code.

4 + 3 + 3 + 3 + 2

9. a) A code is composed of dots and dash. Assume that the dash is 3 times as long as the dot and has a one-third the probability of occurrence –

i) calculate the information in a dot and that in dash.

ii) calculate the average information in the dot-dash code.

iii) assume that dot lasts for 10ms and that this same time interval is allowed between symbols. Calculate the average rate of information transmission. 4 + 4 + 5

b) What is mutual information ? 2

10. a) Find the generator polynomial of a triple-error correcting BCH code with block length n = 31 over $GF(2^5)$. 5

b) Given that the codewords $c_1(x)$ and $c_2(x)$, belonging to the double-error correcting (15, 7) code constructed over GF(2^4), incur 2 and 1 errors so giving –

i) $v_1(x) = x^{11} + x^9 + x^8 + x^6 + x^5 + x + 1$

ii) $v_2(x) = x^{12} + x^{11} + x^{10} + x^9 + x^7 + x^5 + x$

respectively, determine $c_1(x)$ and $c_2(x)$. 5 + 5

11. a) A memoryless source emits six messages with probabilities 0·3, 0·25, 0·15, 0·12, 0·1, 0·008. Find the quaternary Huffman code. Determine its average word length, the efficiency and the redundancy.

b) Explain about Entropy of a source. Briefly discuss about channel capacity of a discrete memoryless channel.

c) What is conditional entropy ?

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

a) BCH code

b) RC ciphers

c) cryptography

d) Hamming code

e) Huffman code.

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