M 26156

Reg. No. : ....

Name : ....

VII Semester B.Tech. Degree (Reg./Sup./Imp. – Including Part Time) Examination, November 2014 (2007 Admn. Onwards)

PT2K6/2K6 EC 703 : INFORMATION THEORY AND CODING

Time: 3 Hours

Max. Marks : 100

Instruction : *Answer **all** questions.*

PART – A

Each question carries **5** marks.

I. a) Define self information. Give its units and properties.

b) State and explain channel coding theorem.

c) Define groups. Explain modulo-operations on group elements by taking a finite group with five elements.

d) What is an irreducible polynomial ? Explain with an example.

e) Define G and H matrix. Give its structure for (n, k) linear block codes.

f) Give the characteristics of BCH codes and briefly explain its encoding principle.

g) Explain the working of a convolution encoder in frequency domain.

h) What is interleaving ? Explain the working principle of bit interleavers and block interleavers. **(8×5=40)**

PART – B

Each question carries **15** marks.

II. a) Given a binary source with $p(0) = \frac{1}{4}$ and $p(1) = \frac{3}{4}$. Find the entropy of this source and of its second extension and hence show that $H(S^2) = 2H(S)$. **5**

P.T.O.

b) Define marginal and joint entropy. Derive the relationship between, H(Y), H(X), H(X/Y), H(Y/X) and H(X, Y).

Verify the above relations for the joint probability matrix given below. **10**

P(X, Y) X\Y

0.2	0	0.2	0
0.1	0.01	0.01	0.01
0	0.02	0.02	0
0.04	0.04	0.01	0.06
0	0.06	0.02	0.2

OR

III. a) P.T. $H(X) \leq \bar{L} \leq H(X) + 1$ for a discrete memoryless source with entropy H(X) and $\bar{L}$ is the average code word length. **7**

b) Using Shannon-Fano coding method encode the given source output alphabets with corresponding probabilities. Find efficiency and redundancy of the code.

Symbols : A B C D E F G H

$p(x_i)$: 0.3, 0.2, 0.15, 0.12, 0.10, 0.07, 0.04, 0.02 respectively. **8**

IV. a) Make a mod-7 addition and multiplication table over GF(2). **7**

b) Construct an extended field of GF(2), with 16 entries, using a primitive polynomial $p(X) = 1 + X + X^4$ over GF (2). **8**

OR

V. a) Check for linear dependency on the following 5-tuples over GF (2).
(10110), (01001) and (11111). **7**

b) If f(X) is a polynomial with coefficients from GF(2). Let β be an element in an extension field of GF(2). Then if β is a root of f(X), then for any $l \geq 0$, show that β^{2^l} is also a root of f(X). **8**

VI. Consider a systematic (8, 4) code whose parity check equations are

$p_0 = u_1 + u_2 + u_3$

$p_1 = u_0 + u_1 + u_2$

$p_2 = u_0 + u_1 + u_3$

$p_3 = u_0 + u_2 + u_3$

where u_0, u_1, u_2 and u_3 are message digits and p_0, p_1, p_2 and p_3 are parity check digits.

i) Find the generator and parity check matrices for this code.

ii) Show that the minimum distance of this code is 4.

iii) Construct an encoder for the above code.

iv) Construct a decoder for the above code. 15

OR

VII. a) i) Construct an encoder circuit for the (7, 4) cyclic code generated by $g(X) = 1 + X + X^3$.

ii) Construct a 3-stage syndrome circuit with input fed from left end.

iii) For the received vector (0010110), find the syndrome bits, with the above circuit.

iv) With block diagram, explain the working of a Meggit decoder, for the above encoder. 15

VIII. Consider a (3, 1, 2) convolution coder with $g^{(1)} = (110)$, $g^{(2)} = (101)$ and $g^{(3)} = (111)$;

i) Draw the encoder diagram and explain its working.

ii) Sketch the code tree of this encoder.

iii) Find the codeword corresponding to the information sequence (11101) using frequency domain approach.

OR

IX. Explain about the following :

i) ML decoding of convolution codes.

ii) Turbo encoder and decoder block diagrams.