Seat No.: ________ Enrolment No.______________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2013

Subject code: 710402 **Date: 04-06-2013**

Subject Name: Information Theory and Coding

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** State and prove Kraftôs inequality theorem **07**

(b) Discuss uniquely decodable code. Check whether the source C={ac, bc, bca, ca, cb} is uniquely decodable or not? **07**

Q.2 **(a)** For the following source symbols and probability, arithmetic code number is 0.386. It is generated by applying arithmetic code on a four symbol sequence. **07**

Symbol	A	B	C	D	E
Probability	0.25	0.25	0.2	0.15	0.15

(b) Explain Shannon-Fano algorithm with a suitable example. Compare its performance with Huffman coding technique. **07**

OR

(b) State, prove and explain Shannonôs noiseless coding theorem **07**

Q.3 **(a)** Prove that the source entropy, *H(S)* will always be lesser or equal to the average code length (L_{min}) of a code. **07**

(b) State and prove the relation between information rate, reliability and channel capacity for a noisy binary symmetric channel (BSC). **07**

OR

Q.3 **(a)** For a binary symmetric channel (BSC), find H(X), H(Y), H(X|Y), H(Y|X) and I(X|Y). Let $P(y_1|x_1) = 2/3$, $P(y_2|x_1) = 1/3$, $P(y_1|x_2) = 1/10$, $P(y_2|x_2) = 9/10$, $P(x_1) = 1/3$ and $P(x_2) = 2/3$. **07**

(b) Prove that for an n symbol source S, the entropy is maximum when the symbols are equiprobable. **07**

Q.4 **(a)** Write notes on *standard array* and error *detection* and *correction* of the linear block codes **07**

(b) For a cyclic code prove that syndrome polynomial s(X) is the remainder of r(X) modulo g(X). **07**

OR

Q.4 **(a)** Construct a systematic (7,4) cyclic code using the generator polynomial $g(x)=x^3+x+1$ for data words 1111,1110,1101 and 1100. **07**

Q.4 **(b)** Write a short note on Reed-Solomon code. **07**

Q.5 **(a)** Consider the following (k+1, k) systematic linear block code with the parity-check digit C_{k+1} given by **07**

$C_{k+1}=d_1+d_2+$é $+d_k$

(i) Construct the appropriate generator matrix for this code.

(ii) Construct the code generated by this matrix for k=3.

(iii) Determine the error detecting or correcting capabilities of this code.

(iv) Show that $cH^T=0$ and $rH^T=0$ if no error occurs, $rH^T=1$ if single error occurs.

(b) Write a short note on Data Encryption Standard. **07**

OR

Q.5 **(a)** Find a generator matrix G for a (15,11) single-error correcting linear block code. Find the code word for the data vector 10111010101. **07**

(b) Break the following columnar transposition cipher. The plain text is from a popular computer textbook, so ñcomputerò is a probable word. The plain text consists entirely of letters (no spaces). The cipher text is broken up into blocks of five characters for readability. **07**

aauan cvlre rurnn dltme aeepb ytust iceat npmey iicgo
gorch srsoc nntii imiha oofpa gsivt tpsit lbolr otoex.

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