Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 2710502 **Date: 08-01-2015**

Subject Name: Information Theory and Coding

Time: 02:30 pm - 05:00 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)**	Briefly explain the following : Information ii) Binary symmetric channel iiii) Block Codes	**07**
	(b)	i) State and prove McMillan theorem.	**04**
		ii) What is a finite state machine?	**03**
Q.2	**(a)**	i) What is mutual information? Show that mutual information has the symmetric property i.e. $I(x_j ; y_k) = I(y_k ; x_j)$.	**03**
		ii) Prove that instantaneous codes always satisfy the Kraftôs inequality.	**04**
	(b)	Discuss soft-decision Viterbi decoding.	**07**
		OR	
	(b)	Find the channel capacity of a channel of infinite bandwidth. Why does it not become finite?	**07**
Q.3	**(a)**	Explain why R-S performs so well in a bursty noise environment? Evaluate R-S performance as a function of size, redundancy, code rate.	**07**
	(b)	The source alphabets A,B,C,D,E,F appear with probabilities 0.4, 0.1, 0.1, 0.1, 0.2, 0.1 respectively. i) Find a binary Huffman code. ii) Find ternary Huffman code. Compare the efficiencies of both the above.	**07**
		OR	
Q.3	**(a)**	Describe any decoding technique for the binary double error correcting BCH codes.	**07**
	(b)	A discrete memory less source emits messages m_1 and m_2 of probabilities 0.8 and 0.2 respectively. Obtain the optimum code for this source. Also find the second and third order extensions (i.e. N = 2 and 3). What is the code efficiency in each case?	**07**
Q.4	**(a)**	Discuss Golay code, a perfect code for triple errors.	**07**
	(b)	Consider a Hamming (7,4,3) code with parity check matrix $H = \begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$ Sketch the trellis diagram for this block code.	**07**
		OR	
Q.4	**(a)**	Derive the equation for channel capacity of a discrete memory less channel.	**07**
	(b)	Construct a systematic (7,4) cyclic code using generator polynomial $g(x) = x^3 + x^2 + 1$ for the data vectors 1010, 1111, 0111, 0110.	**07**
Q.5	**(a)**	Write the algorithm for Arithmetic coding with an example. What are the applications of Arithmetic coding.	**07**
	(b)	Discuss in detail the Data Encryption Standard.	**07**

OR

Q.5	**(a)**	i) Describe the JPEG standard for lossless compression.	**03**
		ii) With the help of an example discuss the algorithm of JPEG standard for lossy compression	**04**
	(b)	Explain the idea behind Rabin cryptosystem. What are the one-way function and the trapdoor in this system.	**07**

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