Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. 1ST Semester Remedial Examination –July- 2011

Subject code: 710203

Subject Name: Information Theory and Coding

Date:11/07/2011 **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)** Explain the following terms. **07**

1) Coding Efficiency
2) Information
3) Information rate.
4) Channel Capacity.
5) Entropy
6) Redundancy
7) Memory less source

(b) A source having five messages is encoded using the following four coding schemes. Which coding technique is the most efficient one and why? **07**

Symbol	Probability	Code 1	Code 2	Code 3
m_1	0.4	1	1	1
m_2	0.2	01	10	000
m_3	0.2	000	110	001
m_4	0.1	0010	010	011
m_5	0.1	0011	0011	010

Q.2 **(a)** Let S have source alphabet (s_1, s_2) with p_1=8/10, p_2=2/10. Then S^2 has source alphabet ($s_1 s_1$, $s_1 s_2$, $s_2 s_1$, $s_2 s_2$) with probabilities 64/100, 16/100, 16/100 & 4/100. Find the probability distribution for S^3 and show that binary Huffman code C^3 for S^3 has average word length $L_3=L(C^3)=0.728$. **07**

(b) What is the need of instantaneous codes? Explain the instantaneous codes in detail with suitable example. **07**

OR

(b) What is the need of uniquely decodable codes? Discuss uniquely decodable code using example. **07**

Q.3 **(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) Confirm the possibility of a (18,7) binary code that can correct up to three errors. Can this code correct up to four errors? **07**

OR

Q.3 **(a)** Consider the following (k+1, k) systematic linear block code with the parity-check digit c_{k+1} given by **07**

$C_{k+1}=d_1+d_2+\ldots+d_k$

(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) Consider a generator matrix G for a nonsystematic (6,3): **07**

$$G = \begin{pmatrix} 1\,0\,0\,0\,1\,1 \\ 0\,1\,0\,1\,0\,1 \\ 0\,0\,1\,1\,1\,0 \end{pmatrix}$$

Construct the code for this G, and show that the minimum distance between code words is 3.

Q.4 **(a)** Prove that after some iteration, Markov source state transition matrix achieves a steady state. **07**

(b) Construct a single-error correcting (7, 4) linear block code (Hamming Code) and the corresponding decoding table. **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**

(b) Explain lossy JPEG image compression standard. **07**

Q.5 **(a)** Write a short note on public key cryptography. **07**

(b) Write a short note on Reed Solomon Codes. **07**

OR

Q.5 **(a)** Explain the columnar cipher with an example. **07**

(b) Write a note on Arithmetic codes. **07**

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