

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2013****Subject code: 712703N****Date: 13-06-2013****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) Why coding is required? Describe unique decodable codes and instantaneous decodable codes with example. **07**
- (b) What is entropy of source? Consider a discrete memory less source with source alphabet $S = \{s_1, s_2, s_3\}$ with probabilities $p(s_1) = \frac{1}{4}$, $p(s_2) = \frac{1}{4}$, $p(s_3) = \frac{1}{2}$. Find entropy of the source. **07**

- Q.2** (a) How convolution code differ from block code? Explain construction of convolution code with example. **07**
- (b) Consider a discrete memory less source with alphabet $\{s_1, s_2, s_3\}$ and statistics $\{0.7, 0.15, 0.15\}$ for its output. (i) Apply the Huffman algorithm to the source and find average code word length. (ii) Let the source extended to order two. Apply the Huffman algorithm to the extended source and find average code word length. (iii) Compare the average code word length calculated in part(ii) with entropy of original source and give your conclusion. **07**

OR

- (b) A communication channel has a bandwidth of 3.4KHz and output SNR = 20dB. Source has total of 128 symbols. Assume that symbols are equiprobable and the successive transmissions are statistically independent. (i) Calculate the channel capacity. (ii) Calculate the maximum symbol rate for which error-free transmission over the channel is possible. **07**
- Q.3** (a) Explain Arithmetic Coding. **07**
- (b) Consider a BSC as shown in figure.1. Find the probabilities of the binary symbols 0 and 1 appearing at the channel output, (i) input binary symbol 0 and 1 occur with equal probabilities and (ii) 0 and 1 occur with probabilities $\frac{1}{4}$ and $\frac{3}{4}$. **07**

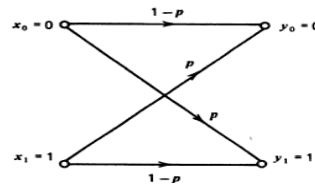


Figure: 1 Binary Symmetric Channel (BSC) of Q.3(b)

OR

- Q.3** (a) Write short note on Loss less image compression. **07**
- (b) What is Mutual information? What is the relation between Mutual information and channel capacity? Derive the capacity of a channel with infinite bandwidth. **07**
- Q.4** (a) What is the difference between systematic and nonsystematic linear block codes. Show $GH^T = 0$. 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**

- (b) Consider the following $(k+1, k)$ systematic linear block code with the parity check digit C_{k+1} given by $C_{k+1} = d_1 + d_2 + \dots + d_k$ 07
 (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.

OR

- Q.4** (a) State and derive the Hamming bound for the linear block code. Whether golay's code $(23,12)$ satisfy it exactly or not? 07
 (b) For the given generator matrix, the constructed code is systematic or nonsystematic? 07
 Find the minimum distance between the code word and determine error correcting and detecting capability. Decode the received word 10110.

$$G = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

- Q.5** (a) Explain maximum likelihood decoding of convolution code with example. 07
 (b) Explain Asymmetric-Key cryptography. 07
- OR**
- Q.5** (a) Explain sequential decoding of convolution code with example. 07
 (b) Explain Symmetric-Key cryptography. 07
