

**GUJARAT TECHNOLOGICAL UNIVERSITY****PDDC SEM-VI Examination May 2012****Subject code: X61101****Subject Name: Digital Communication****Date: 08/05/2012****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 conditional probability with example and derive Bayes' rule. A random experiment consists of drawing two cards from a deck in succession (without replacing the first card drawn). Assign a value to the probability of obtaining two red aces in two draws. **07**

**(b)** Explain Cumulative Distribution Function (CDF) of random variable with its properties. In a random experiment, a trial consists of four successive tosses of a coin. If we define an RV  $x$  as the number of heads appearing in a trial, determine probabilities  $P_X(x)$  and CDF  $F_X(x)$ . **07**

**Q.2 (a)** Answer the following questions: **07**

1. A binary source generates digits 1 and 0 randomly with probabilities  $P(1)=0.8$  and  $P(0)=0.2$ .

(i) What is the probability that two 1's and three 0's will occur in a five-digit sequence?

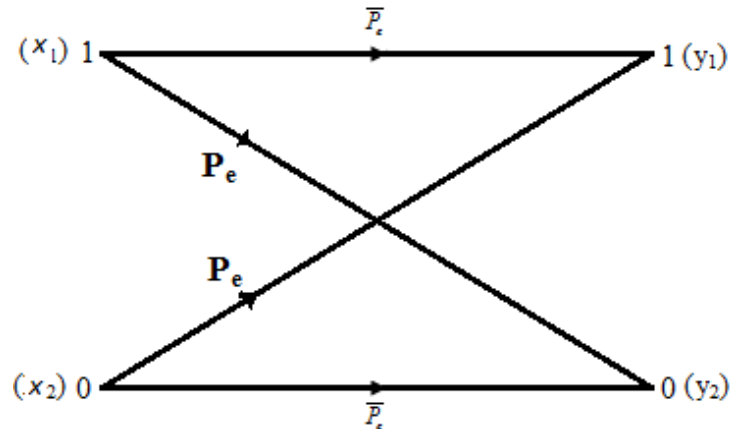
(ii) What is the probability that at least three 1's will occur in a five-digit sequence?

2. Explain Chebyshev's Inequality.

**(b)** Describe 'Entropy of a source' in brief and prove  $0 \leq H(m) \leq \log n$ , where  $H(m)$  is the entropy of a source and  $n$  is the number of messages emitted by the source. **07**

**OR**

**(b)** Find the channel capacity of the Binary Symmetric Channel (BSC) shown in figure below. **07**



**Q.3 (a)** A source emits three equiprobable messages randomly and independently. **07**

1. Find the source entropy.

2. Find the compact ternary code, the average length of the codeword, the code efficiency and the redundancy.
3. Repeat part (2) for a binary code.
4. To improve the efficiency of a binary code, now code the second extension of the source. Find a compact binary code, the average length of the codeword, the code efficiency and the redundancy.

- (b) For a (6,3) systematic linear block code, the three parity-check digits  $p_4$ ,  $p_5$ , and  $p_6$  are **07**

$$p_4 = d_1 + d_2 + d_3$$

$$p_5 = d_1 + d_2$$

$$p_6 = d_1 + d_3$$

1. Construct the appropriate generator matrix for this code.
2. Construct the code generated by this matrix.
3. Determine the error correcting capabilities of this code.
4. Prepare a suitable decoding table
5. Decode the received word :**101100**

**OR**

- Q.3** (a) 1. Explain Convolutional coder with suitable example. **05**  
 2. Golay's (23, 12) codes are three-error correcting codes. Verify that  $n=23$  and  $k=12$  satisfies the Hamming bound exactly for  $t=3$ . **02**
- (b) Construct a systematic (7, 4) cyclic code using the generator polynomial  $g(x) = x^3 + x^2 + 1$ . **07**

- Q.4** (a) Answer the following questions: **07**
1. State and prove the sampling theorem.
  2. A signal  $m(t)$  of bandwidth  $B=4\text{kHz}$  is transmitted using a binary companded PCM with  $\mu=100$ . Compare the case of  $L=64$  with the case of  $L=256$  from the point of view of transmission bandwidth and the output SNR.
- (b) Explain the operation of Delta Modulation (DM) using block diagram and necessary waveforms. Discuss the need of Adaptive Delta Modulation. **07**

**OR**

- Q.4** (a) Answer the following questions: **07**
1. Describe "Timing Extraction" required to sample incoming pulses at precise instants in regenerative repeater.
  2. What is capacity of AWGN channel of infinite bandwidth? Show that for finite signal and noise powers, the channel capacity always remains finite.
- (b) Explain Binary-Phase Shift Keying (BPSK) technique in detail. What is advantage of Differential Phase-Shift Keying (DPSK) over BPSK? **07**

- Q.5** (a) List out desirable properties of line coding. Also find the Power Spectral Density (PSD) of polar signaling. **07**
- (b) Explain Nyquist's Criterion for zero ISI **07**

**OR**

- Q.5** (a) What is the difference between coherent and non-coherent detection techniques? Describe coherent detection of FSK signal. **07**
- (b) Discuss optimum binary receiver in brief. **07**

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