Department of Electronics & Communication Engineering.
Bundelkhand Institute of Engineering & Technology, Jhansi.

Assignment Sheet 3

Information Theory and Coding (DC 13)

Instructor: Yogendra Kumar Prajapati
Due Date :
Problems : 10

1. Define the following with respect to the markov sources
   (A) Transient state
   (B) Irreducible state
2. Explain Discrete Communication channel and also give the appropriate mathematical expression for the same.
3. Explain equivocation of the channel.
4. An additive white Gaussian noise channel has the output Y = X + G where X is the channel input and G is the noise with probability density function

   $$P(n) = (1/(\sqrt{(2*\pi*\sigma_n)}))*\exp(-n^2/2*\sigma_n^2)$$

   If x is define as the white gaussian input with $E(X) = 0$ and $E(X^2) = \sigma_x^2$
   Determine
   (A) The conditional entropy H(X/Y)
   (B) The average mutual information I(X : Y)
5. Consider the binary symmetric channel where $P(X_0) = \alpha$ and $P(X_1) = (1- \alpha)$.
   Value of P_{01} is (1-p) and P_{11} is (p). Find
   (A) Average mutual information between the channel input and output.
   (B) Channel capacity

6. Write down Shannon Harley Law. Explain its mathematical form. Write down the application of the same.
7. An analog signal having 4 kHz bandwidth is sampled at 1.25 times of the nyquest rate and each sample quantized into one of 256 equally likely level. Assume that samples to be statically independent.
   (A) Information rate
   (B) Can output of this source transmitted without error over a AWGN channel with a bandwith of 10 KHz and S/N ratio of 20 DB.
   (C) Find S/N ratio for error free transmission of part (B).
   (D) Find bandwidth required for an AWGN channel for an error free transmission of the output of this source if S/N ratio is 20 DB.
8. Write down the short note on discrete memory less channel.
9. Verify that
   $0 \le H(X) \le \log_2 m$
   Where m is the size of the alphabet of X.
10. Consider a DMS X with symbols X_k and corresponding probabilities $p(x_k) = p_k$ where k = 1,..,k.
   Let n_k be the length of the code word x_k such that
   $-\log_2(p_k) \le n_k \le -\log_2(p_k) + 1$

Show that this relationship satisfy the kraft inequality and find the bound on K.