DCS- Sample Question Bank

- Define the following with respect to information theory i) Entropy ii) Rate of Information iii) Self information
- Develop the relation between Hartley, Nat and Bits.
- Develop an expression for average information content (entropy) of long independent message
- Explain digital communication system with block diagram.
- A binary source emitting an independent sequence of 0's and 1's with probabilities p and (1-p) respectively. Plot the entropy of the source.
- List the properties of Entropy & obtain an expression for maximum Entropy of a system.
- Show that the entropy of a discrete memory less source will become maximum when all source symbols are equally probable. What is the maximum value of entropy?
- Illuminate on the concept of amount of information associated with message.
- A code is composed of dots and dashes. Assume that the dash is 3 times as long as the dot and has one-third the probability of occurrence. (i) Assess the information in dot and that in a dash; (ii) Estimate the average information in dot-dash code; and (iii) Assume that a dot lasts for 1 ms and this same time interval is allowed between symbols. Examine the average rate of information of transmission.
- A source has 2 symbols alpha and beta. The duration of alpha is 0.2 sec, beta duration is 3 times of alpha duration. The probability of alpha is twice that of beta and time between each symbol is 0.2 sec. Calculate the information rate of the source.
- An analog signal band limited to 8 KHz is sampled at twice the Nyquist rate and then quantized into 16 level, out of which 4 levels occur with a probability of 1/4 each 4 with 1/8 each and remaining 8 levels with probability 1/16 each respectively. Determine the information rate associated with the analog signal.
- A card is drawn from a deck of playing cards. i) You are informed that the card you draw is spade. How much information did you receive in bits? ii) How much information did you receive if you are told that the card you drew is an ace? iii) How much information did you receive if you are told that the card you drew is an ace of spades? iv) Is the information content of the message "ace of spades" the sum of the information contents of the messages "spade" and "ace"?
- A black and white TV picture consists of 525 lines of picture information. Assume that each consists of 525 picture elements and that each element can have 256 brightness levels. Pictures are repeated the rate of 30/sec. Estimate the average rate of information conveyed by a TV set to a viewer.
- A zero memory source has a source alphabet S= {S1, S2, S3} with P= {1/2, 1/4, 1/4}. Estimate the entropy of the source.
- Apply Shannon's binary Encoding procedure to the following set of messages and obtain the code efficiency and redundancy for 1/8, 1/16, 3/16, 1/4, 3/8
- Using Shannon's Binary Encoding procedure, Construct codes for {S1, S2, S3} with Probabilities {1/2, 1/5, 3/10}. Evaluate code efficiency and redundancy.
- Consider a discrete memoryless source with alphabets {S1,S2,S3,S4,S5,S6} with {0.4,0.2,0.2,0.1,0.07,0.03}. Apply Huffman algorithm to construct Binary Code and Ternary codes for the source by placing the composite symbols as low as possible. Also find efficiency in each case.
- Given the messages s_1, s_2, s_3 and s_4 with respective probabilities of 0.4, 0.3, 0.2 and 0.1, construct a binary code by applying Huffman encoding procedure. Determine the efficiency and redundancy of the code so formed.

- Consider a Zero memory source with S=[S1,S2,S3,S4,S5,S6,S7] and Probabilities
  P = [0.4, 0.2, 0.1, 0.1, 0.1, 0.05, 0.05]
  i. Construct a binary Huffman code by placing the composite symbol as low as possible.
  ii. Repeat (i) by moving a composite symbol as high as possible.
  iii. In each of the cases (i) and case(ii) above,
    - Compute the variances of the word lengths and comment on the result.
    - Find Efficiency and Redundancy.
  iv. Considering Case(ii) table,
    - Write the code tree and decode the message 01110110011000100……
    - Determine probabilities of 0's and 1's.
- Consider a Zero memory source with S=[S1,S2,S3,S4,S5] and Probabilities
  P = [0.4, 0.2, 0.2, 0.1, 0.1]
  i. Construct a binary Huffman code by placing the composite symbol as low as possible.
  ii. Repeat (i) by moving a composite symbol as high as possible.
  iii. In each of the cases (i) and (ii) above,
    - Compute the variances of the word lengths and comment on the result.
    - Find Efficiency and Redundancy.
  iv. Considering case (ii) table,
    - Write the code tree and decode the message 1000011010….
    - Determine probabilities of 0's and 1's.
- Design a trinary source code for the source shown using Huffman's coding procedure
  $S = \{s_1, s_2, s_3, s_4, s_5, s_6\}$,P= $\left\{\frac{1}{3}\ \frac{1}{4}\ \frac{1}{8}\ \frac{1}{8}\ \frac{1}{12}\ \frac{1}{12}\right\}$, X={0 1 2}. Also determine efficiency and redundancy
- Consider a source with 8 alphabet A to H with respective probabilities of
  0.22, 0.20, 0.18, 0.15, 0.10, 0.08, 0.05, 0.02.
  i] Construct a binary compact code and determine the code efficiency.
  ii] Construct a ternary compact code and determine efficiency of the code
  iii] Construct a quaternary compact code and determine the code efficiency.
  iv] Compare and comment on the result.
  v] Construct the code trees for all three cases and decode the messages using appropriate code trees
    a) 0101001000001101011001…
    b) 12111011020012002 ….
    c) 031132020300100231 …..
- What is channel, channel matrix, Noise diagram, Joint probability Matrix? Construct Channel matrix and represent as channel or noise diagram.