UNIT-2
Information Theory & Coding

1) Derive and explain the relation between the amount of information provided and probability of occurrence of events.
2) What is source coding? Define code length & code efficiency. Give the relation between it.
3) A discrete source emits one of five symbols once every milliseconds with probabilities 1/2, 1/4, 1/8, 1/16 and 1/16. Find the source entropy and information rate.
4) Compute the Huffman code by placing the probability of the combined symbol as high as possible. What is the average code-word length? Also calculate code efficiency.

Symbol	S_0	S_1	S_2	S_3	S_4	S_5	S_6
Probability	0.25	0.25	0.125	0.125	0.125	0.0625	0.0625

5) A zero-memory source emits six messages with probabilities 0.3, 025, 0.15, 0.12, 0.1 and 0.08. Find the 4-ary Huffman code. Determine its average word length, the efficiency and the redundancy.
6) Discuss the practical communication system in lights of Shannon theorem.
7) Define G and H matrix for linear block code and explain encoding & decoding process.
8) For a (6,3) linear block code, the Generator matrix G is:

$$\begin{matrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{matrix}$$

For all eight possible data words, find the corresponding code words & verify that this code is a single-error correcting code.

9) For a (6,3) linear block code, the Generator matrix G is:

$$\begin{matrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{matrix}$$

Obtain the parity check matrix and check whether the received code word 10011 is correct. If not, determine the correct transmitted codeword.

10) For a (7, 4) cyclic code, 4-digit divisor used is 1011.
    - **a.** Generate the codeword at sender site for given dataword: 1001
    - **b.** Show the checking of received code word 100110 at receiver site.

11) For a (7,4) linear block code:

$$\begin{matrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 0 \end{matrix}$$

Obtain the parity check matrix and check whether the received code word 1110111 is correct. Also, find the corresponding decoding table.

12) Given the dataword 1010101010 and the divisor 10111,

- **a.** Show the generation of codeword at the sender site (Using binary Division)
- **b.** Show the generation of dataword at receiver site (assuming no errors)

13) Explain the working of (N=3, x=2, k=4) convolutional encoder using Encoding table and code tree approach.

14) Draw the state diagram & trellis diagram of (N=3, x=2, k=4) convolutional encoder.

15) Explain the maximum likelihood (Viterbi) decoding algorithm of a convolution encoder with suitable example.

16) The signal-to-noise ratio is often given in decibels. Assume that SNR = 36 dB and the channel bandwidth is 2 MHz. Calculate the theoretical channel capacity.

17) We have a channel with 1-MHz bandwidth. The SNR for this channel is 63. What are the appropriate bit rate and signal level?

18) Explain the practical communication system in the light of Shannon's Theorem.

19) Relate the Nyquist theorem with Shannon's theorem and derive the relationship between SNR and no of signal levels.

20) Noise is -30 dBW and signal strength is -20 dBW. Signal is transmitted with 1 MHz channel bandwidth. Find out maximum channel capacity in bps. How many signal levels will be required?