Duration: (3 Hours) **[Total Marks: 80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1. Attempt any Four:-
   (a) Define mutual information and average mutual information. 05
   (b) Construct Lempel-Ziv code for the given data sequence 05
   0 0 1 0 0 0 0 0 0 0 0 0 1 1 0.
   (c) Calculate the channel capacity of a BSC with a conditional error probability of 0.2 05
   (d) Calculate the channel capacity of a Gaussian channel with a bandwidth of 3 kHz and SNR of 15. 05
   (e) Explain the principles of video compression. 05

2. (a) For a binary channel $p(x_1) = 0.4$, $p(x_2) = 0.6$, $p(y_1/x_1) = 0.8$ and $p(y_2/x_2) = 0.7$, where X is the input random variable and Y is the output random variable. Calculate $p(x_1/y_1)$, $p(x_2/y_1)$, $p(x_2/y_2)$, $p(x_1/y_2)$. 10

   (b) Calculate the average mutual information I (X;Y) for the above channel. 10

3. (a) A discrete memory less source has an alphabet of three symbols with probabilities for its output as described in Table. Generate minimum variance second order extended Huffman code. 10

Symbol	S_1	S_2	S_3
Probability	0.6	0.3	0.1

   (b) A discrete memory less source has an alphabet of three symbols with probabilities for its output as described in Table. Generate minimum variance second order extended Shannon-Fano code. 10

Symbol	S_1	S_2	S_3
Probability	0.6	0.3	0.1

4. (a) Generator matrix of a (5,2) linear block code is given below: 10

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

   i) Find the code word for the data 11.
   ii) Determine d_{min} and correction capability of the given code.
   iii) Decode the data sequence from the received code 11110.

   (b) Generator matrix of a (8,4) linear block code is given below: 10

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

i) Find the code word for the data 1011.
ii) Determine d_{min} and correction capability of the given code.
iii) Decode the data sequence from the received code 11110100.

5. (a) For a (7,4) cyclic code , the generator polynomial is $G(x) = x^3 + x^2 + 1$ 10
i) Find the systematic cyclic code word for the data 1000.
ii) Determine d_{min} and correction capability of the given code.
iii) Decode the data sequence from the received code 1100011.

(b) For a (7,4) cyclic code , the generator polynomial is $G(x) = x^3 + x + 1$ 10
i) Find the systematic cyclic code word for the data 0100
ii) Determine d_{min} and correction capability of the given code
iii) Decode the data sequence from the received code 0000101.

6. (a) Generator sequences of a (2,1,1) convolutional encoder are given below: 10
g(1) = 11 and g(2) = 10.
i) Sketch the encoder.
ii) Determine the impulse response.
iii) Find the code for the data 00111.
iv) Sketch the tree diagram and using it decode the data from the received code 1110111000.

(b) Generator sequences of a (2,1,2) convolutional encoder are given below: 10
g(1) = 111 and g(2) = 101.
i) Sketch the encoder.
ii) Determine the code efficiency and constraint length.
iii) Find the code for the data 01011.
iv) Sketch the trellis diagram and using it decode the data from the received code 111000101100.

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