Time: 3 Hours **Marks: 80**

NB. 1. Question No. **1** is **compulsory**.
2. Attempt **any three** out of remaining five questions.
2. Figures to right indicate full marks.
3. Assume data wherever required and state it clearly.

Q1 20
a) Stating the relationship between PDF and CDF, give the properties of PDF.
b) Define Entropy of an information source? When is the entropy maximum?
c) Over a long transmission line draw the following data format for the binary sequence 10011101011.
   i) Unipolar NRZ   ii) Polar RZ   iii) Manchester
   Select the best and justify the answer.
d) Explain the role of Hamming distance in error detection & correction?
e) For impulse responses $g^1=\{1,1,0\}$, $g^2=\{0,1,0\}$, $g^3=\{1,1,1\}$ design the state diagram.

Q2
a) A discrete memoryless source has an alphabet of six symbol with their probabilities as shown: 10

Symbol	M_1	M_2	M_3	M_4	M_5	M_6
Probability	0.3	0.25	0.15	0.12	0.08	0.10

   i) Determine the Minimum Variance Huffman code-words and average code-word length and hence find Entropy of the system.
   ii) Verify the average code-word length using Shannon Fano.
   iii) Compare and comment on the results of both

b) A convolution encoder has a constraint length of 3 and code rate of 1/3. The impulses for each are $g^1=100$ $g^2=101$ $g^3=111$. Draw 10

   i) encoder
   ii) state diagram
   iii) code transfer function

Q3
a) State and prove the Conditional Probability. 10
b) Draw the signal space diagram for 16-PSK and 16-QAM and find their error probability. Also draw their PSD and determine bandwidth. 10

Q4
a) A parity check matrix of a (7,4) Hamming code is given as follows: 10
$$H = \begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$
   i) Find Generator matrix, using which find out the code-words of 1100 and 0101,
   ii) Determine the error detecting and correcting capability of system,
   iii) Draw the encoder for the above block code.
b) Sketch the encoder and syndrome calculator for the generator polynomial 10

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$g(x)=1+x^2+x^3$ and obtain the syndrome for the received code-word 1101011.

Q5

a) Discuss the problem of inter symbol interference (ISI). Explain the measures to 10 be taken to reduce ISI. How to study ISI using eye pattern?

b) Consider a convolution encoder with the constraint length K=3 and $g^1=\{1,0,1\}$ 10 and $g^2=\{0,1,1\}$. Find the code vector for the message stream 11010 using time domain approach. Verify the code vector using transform approach.

Q6

Explain with the required diagrams **(Any Three):** 20

a) Modified duo-binary encoder
b) Shannon Hartley Theorem for Channel Capacity
c) Need for error control codes.
d) Define the following terms and give their significance

(i) Mean   (ii) Central moment   (iii) Variance   (iv)Standard deviation

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