

(3 Hours)

[Total Marks:80]

N. B.: 1) Question No. 1 is **compulsory**.

2) Attempt **any three** questions out of the remaining five questions.

3) Assume suitable data wherever necessary.

1. Answer the following (any four): 20
  - a Define the mean and variance of random variables.
  - b Explain Poisson's distribution. State its applications.
  - c State and explain Shannon-Hartley Capacity theorem.
  - d What is Nyquist criteria and Nyquist bandwidth?
  - e Differentiate between BPSK and BFSK.
  
2. a Prove that the mean of sum of two random variables is the sum of the mean of the two random variables. 10
  - b The generator polynomial for a (7,4) systematic cyclic code is  $g(x) = 1+x+x^3$ 
    - i) Draw the shift register implementation of encoder and syndrome calculator for this code. 4
    - ii) Find the codeword for the message {0101} 3
    - iii) Assume that the first bit of the codeword in (ii), suffers transmission error. Find the syndrome at the receiver. 4
  
3. a Explain QASK modulation and obtain the expression for its Euclidean distance. 10
  - b Explain BPSK modulator and demodulator with a block diagram. Draw its constellation diagram and find the Euclidean distance. 10
  
4. a A systematic block code has parity check equations as given below:
 
$$p_1 = m_1 + m_2 + m_4 \quad p_2 = m_1 + m_3 + m_4 \quad p_3 = m_1 + m_2 + m_3$$
 where  $m_i$  are the message bits and  $p_i$  are the parity bits.
  - a) Find the Generator matrix and the Parity check matrix for this code 4
  - b) How many errors can be detected and corrected? 4
  - c) If the received codeword is {0010110}, find the syndrome. 2
  - b For the data sequence 11011001 draw the waveforms for following modulation techniques: BPSK, BFSK, MSK, and the original data in NRZ format. 05
  - c Explain Eye pattern with neat diagram. 05
  
5. a A discrete memory less source has an alphabet of five symbols with their probabilities a shown below:
 

Symbol	S1	S2	S3	S4	S5
Probability	0.4	0.19	0.15	0.15	0.11

  - i) Construct Huffman code for each symbol and determine the following parameters: 05  
Entropy, Average code word length, code efficiency and code redundancy.
  - ii) Determine the above parameters for Shannon-Fano code. 05
  - b Explain the duobinary encoding. State the drawbacks of duobinary encoding. How are these drawbacks overcome? 10
  
6. a With a neat diagram, explain the working of the matched filter. Derive the expression for its probability of error. 10
  - b State desirable properties of line codes. 05  
For the data sequence 11011101 draw the following line codes: NRZ-L, NRZ-M, bipolar RZ, AMI, Manchester code. 05