

(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 [20]
  - a Calculate the entropy of the following symbols in bits/symbol and decit/symbol.  
 The symbols are  $S_1$ ,  $S_2$ , and  $S_3$  with probabilities 0.6, 0.3 and 0.1 respectively.
  - b Determine VRC bit for the data sequence 11110011 and show that it can detect 1-bit error.
  - c Compare ISI and ICI
  - d Explain AWGN and matched filter
  - e Find the bandwidth for transmitting 120 bps using QPSK, 4-ary FSK, MSK, 8-ary PSK, and 16-ary QASK
- 2 a Calculate the maximum capacity of a Gaussian channel with a bandwidth of 3 kHz and SNR of 30dB. If the bandwidth is doubled, calculate the new channel capacity. [10]
  - b Parity bits equations of a (6,3) linear block code are given below. Construct generator matrix, parity check matrix and implement encoder & decoder. [10]
 
$$P_3 = D_3 + D_2 + D_1, P_2 = D_3 + D_2, \text{ and } P_1 = D_2 + D_1$$
- 3 a Implement (7,4) cyclic code encoder and decoder using the generator polynomial [10]
 
$$G(x) = x^3 + x^2 + 1$$
  - b Find 3-bit HRC and 3-bit checksum for the data 101011001111 and show that these codes can detect 3 continuous bit errors [10]
- 4 a Generator sequences of a convolutional encoder are given below. Calculate the impulse response of the encoder and sketch trellis diagram and using the trellis diagram determines the codeword for the input message 111. [10]
 
$$g^{(1)} = 111 \text{ and } g^{(2)} = 101$$

- b Sketch and compare NRZ unipolar, NRZ polar, NRZ Manchester and NRZ AMI formats in terms of bandwidth, power requirement, synchronization capability, DC level and polarity inversion error. Data sequence is 0011. [10]
- 5 a Find minimum variance Huffman code and Shannon-Fano code for the symbols  $S_1, S_2, S_3, S_4$  and  $S_5$  with probabilities 0.2, 0.1, 0.4, 0.2 and 0.1 respectively. Compare the efficiencies and variances of the generated codes. [10]
- b Sketch QPSK and offset-QPSK waveforms for the input message 00011011 and explain the advantage of offset-QPSK over QPSK. [10]
- 6 a Derive the PSD of BFSK, sketch the power spectrum and find the bandwidth. [10]
- b Find the error probability of 16-ary QASK using signal space representation and Euclidean distance. [10]
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