(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 if required, stating them clearly.

Q. 1 **Answer the following questions: (any four)** (20)

(a) For the bit sequence 10011101 draw the following line codes:
i) Polar RZ ii) AMI-RZ iii) Manchester iv) Unipolar NRZ

(b) State Shannon's theorem for Channel capacity. A Gaussian channel has 2MHz bandwidth. Calculate its Channel Capacity if the Signal to Noise Spectral density ratio is 10^4. Also calculate its maximum Information Rate.

(c) What are the properties of Matched Filter? Explain

(d) Define Bandwidth efficiency. Find the required bandwidth (Null-to-Null BW) of the following systems: BFSK, 16-PSK ,16- QASK , 16-FSK and QPSK , when Digital data is to be transmitted at a rate of 32 kbps.

(e) For a convolutional encoder with code rate 1/3 and constraint length 3 and generating Vectors g1= (1 1 1) , g2= (1 0 1) , g3= (1 1 0). (i) draw the encoder and find the codeword for the input sequence 10101. (ii) Sketch its state diagram

Q 2 (a) A discrete memory less source emits six messages with their probabilities as shown below: (10)

Symbol	S1	S2	S3	S4	S5	S6
Probability	0.12	0.26	0.18	0.34	0.4	0.06

Construct Huffman Code, find the Entropy of the source. Obtain the compact binary code and find the Average length of the Code, Code Efficiency and Code Redundancy

(b) What is ISI? What causes ISI? Derive the expression for ISI. Explain the methods to control the effect of ISI (10)

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Q.3 (a) With reference to MSK system, explain the following: (10)
(i) Why MSK is called 'shaped QPSK'?
(ii) For the data sequence 101100011, sketch MSK waveform (m=5) on a graph paper

(b) Consider a Systematic block code whose Parity check equations are:

$$C_5 = m_1 + m_2 + m_3$$
$$C_6 = m_2 + m_3 + m_4$$
$$C_7 = m_1 + m_3 + m_4$$
$$C_8 = m_1 + m_2 + m_4$$

(i) find n, k for this code . Construct 'G' and 'H' matrices
(ii) find the codewords for the msg vectors : 1011, 1101
(iii) construct the syndrome look-up table.
(iv) If the received codeword is 10111110, find the error vector from the look-up table and compute the corrected codeword. (10)

Q.4 (a) With reference to Offset-QPSK, explain the following:
(i) transmitter and receiver with a neat block diagram along with mathematical expression for transmitted signal
(ii) sketch its PSD indicating the bandwidth
(iii) draw its constellation diagram and find its Euclidian distance
(iv) Compare OQPSK with QPSK. (4+2+2+2)

(b) Design a Feedback shift register encoder for a (8,5) cyclic code with generator Polynomial g(x) = $(1+ \mathbf{x} + \mathbf{x^2} + \mathbf{x^3})$. **(i)**Find the codeword for the msg 10101, by tracing the path through the encoder in systematic form. (ii) draw the 'syndrome calculator' for the same and find the syndrome if the received codeword is 11010101 (5 +5)

Q.5 (a) With a neat diagram, explain how the Integrate and Dump Filter works as baseband receiver. Derive the expression for its probability of error. (10)

(b) The binary data 010100101 is applied to the input of a duobinary encoder
i) Construct the duobinary coder output and corresponding receiver output without precoding.
ii) Suppose that due to error during transmission, the logic level of the third digit is changed. Construct the new receiver output. What should be done to avoid error propagation? (10)

Q.6 (a) Draw the signal constellation diagrams for 16-PSK and 16-QASK and determine the Euclidian distance and Expression for Symbol Energy, E_S for both systems. Compare them and Comment about which of them has better noise immunity? (10)

(b) Write a short note on: (i) Optical communication system
(ii) Satellite communication system (10)
