

- N.B. : (1) Question No. 1 is compulsory.  
 (2) Solve any four questions from Q. Nos. 2 to 7.  
 (3) Draw neat sketches, wherever necessary.  
 (4) Assume suitable data, wherever necessary and justify it.  
 (5) Figures to the right indicate full marks.

1. (a) For a binary memory source with two symbols  $m_1$  and  $m_2$ , show that entropy  $H(x)$  is maximum when both  $m_1$  and  $m_2$  are equiprobable. What are the lower and upper bounds on  $H(x)$ . 10  
 (b) Prove that for the 16-ary QASK digital modulation technique, the Euclidean distance is given by 4

$$d = 2\sqrt{0.4E_b}$$

Where  $E_b$  is the normalized energy per bit .

- (c) Define the following :  
 (i) Sampling theorem for Bandpass signal. 2  
 (ii) Sampling theorem in frequency domain 2  
 (iii) Linear Block codes. 2
2. (a) A message 101101 is to be transmitted using cyclic code having a generator polynomial  $g(x) = x^4 + x^3 + 1$ . Obtain the transmitted codeword. How many check (parity) bits does the encoded message contain ? Draw a suitable encoder arrangement for the same. 10  
 (b) Derive an expression for signal to noise ratio of an integrate and dump filter and hence explain how the signal is emphasised relative to noise. What is the ideal output at the sampling time ? 10
3. (a) For the convolutional encoder arrangement shown below, draw the state diagram and hence, the trellis diagram. Determine the output sequence for the input data 11010100. What are the dimensions of the code and find its constraint length. Use Viterbi algorithm to decode the sequence 100 110 111 101 001 101 001 010. 12  
 (b) Derive an expression for probability of error of an optimum filter. 8
4. (a) A generator matrix of (6, 3) linear block code is given by:

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

Determine :

- (i) All the code vectors 4  
 (ii) " $d_{min}$ " for the above code 1  
 (iii) Error detection and correction capability 2  
 (iv) If the received sequence is 101101, determine the message bit sequence. 3
- (b) Explain MSK with the help of relevant expressions and waveforms. Sketch the PSD of MSK and QPSK and compare them. 10
5. (a) The binary data [011100101] is applied to the input of a modified duobinary encoder :  
 (i) Construct the modified duobinary coder output and corresponding receiver output without precoding. 5  
 (ii) Suppose that due to error during transmission, the level produced by the third digit is reduced to zero. Construct the new receiver output. What should be done to avoid error propagation ? 5
- (b) In a facsimile transmission of a picture, there are about  $2.25 \times 10^6$  picture elements per frame. Twelve bright levels are required for faithful reception. Assuming all these levels equiprobable, calculate the channel bandwidth required to transmit one picture in every three minutes for a signal to noise power ratio of 30 dB. If SNR requirement is increased to 40 dB, calculate the new bandwidth. Comment on SNR-Bandwidth trade off, for the results obtained in above cases. 10
6. (a) Explain the transmitter and receiver of DEPSK system with block diagram, why error occur in pairs in DEPSK system ? Give suitable example. 10  
 (b) A PN sequence is to be generated using a feedback shift register of length 4. The feedback taps is given as (4, 1). Find the generated output sequence if the initial contents of the shift register are 1000. If the chip rate is  $10^7$  chips/second, calculate : 10  
 (i) Chip duration and PN sequence duration.  
 (ii) Period of output sequence.  
 Also, draw its schematic arrangement.
7. (a) Compare the following :  
 (i) Offset QPSK and non-offset QPSK. 5  
 (ii) Linear block codes and convolution codes. 5
- (b) Write short notes on (any two) : 10  
 (i) Direct Sequence-spread Spectrum.  
 (ii) Adaptive Equalizers.  
 (iii) Eye Patterns and its Application.  
 (iv) BCH Codes.