**(3 hours)** **Total Marks=80**

NB:.
1 Question number 1 is compulsory.
2. attempt any 3 questions front the remaining five questions.
3. Assume suitable data wherever needed.

Q.1 **Attempt any four questions :** 20

a) Explain why digital communication is preferred over analog communication?
b) A rate 1/3 convolutional coder with constraint length of '3' uses the generating vectors as given : $g_1 = 100$, $g_2 = 101$, $g_3 = 111$.
Draw the encoder, state diagram and trellis diagram.
c) Represent the following bit sequence, 1011101011, using i) Unipolar RZ, ii) Unipolar NRZ, iii) Bipolar NRZ, iv) AMI RZ, v) Manchester
d) In the presence of White Gaussian noise, with a constant signal power the channel capacity reaches its upper limit with the increase in the bandwidth B. Prove that this upper limit of C is given by $C_\infty = 1.44(S/N_0)$.
e) Write a note on optimum receiver.

Q.2.a) Why MSK is called 'shaped QPSK'? explain. 10
For the bit sequence, 10110101100 ,draw the MSK waveform (let m=5)
b) A discrete memory less source generates symbols **every one millisecond** as given below: 10

| S | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ |
|---|---|---|---|---|---|---|---|---|
| P | 1 /4 | 1/8 | 1/16 | 1/16 | 1/16 | 1/4 | 1/16 | 1/8 |

Construct Shannon-Fano code. Also find the source entropy, information rate and code efficiency.

Q.3.a) What is ISI? Derive an expression for ISI and explain methods to overcome ISI. State the Nyquist's condition for zero ISI. 10
b) Show that duobinary signaling suffers from error propagation while pre-coded duobinary signaling does not. Explain with encoder and decoder block diagrams and decoding logic. 10

Q.4.a) Explain with the help of a neat block diagram, the transmitter and receiver of M-ary FSK. Also sketch the PSD of M-ary FSK. What is the bandwidth requirement of M-ary FSK? 10
b) Find the generator matrix G for a systematic (7, 4) cyclic code using generator polynomial $g(x)=1+x^2+x^3$ .Design an encoder for the code and verify its operation to determine the codeword for the message vector (1100). 10

Q.5.a) The parity check matrix H of a linear (7,4) block code is given as : 10

$$H = \begin{bmatrix} 1 & 0 & 10 & 1 & 00 \\ 1 & 0 & 11 & 0 & 10 \\ 1 & 1 & 01 & 0 & 01 \end{bmatrix}$$

Determine the code words for the messages: (i) 0011 (ii) 0100 and (iii) 0110
Also show how error is detected when 2nd bit is detected erroneously for data word 0011?
b) Compare BASK, BPSK and BFSK, based on following parameters: Bandwidth, detection method, noise immunity, transmission rate and signal space representation. 5
c) Compare OQPSK with MSK. 5

Q.6.a) Write short notes on : 10
i) optical communication system
ii) Satellite Communication System
b) Sketch the signal constellation diagram (d=2a) for 16-QAM system and Derive the expression for its Symbol energy, $E_S$. Prove that the noise immunity of 16-QAM is better than that of 16-PSK system. 10

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