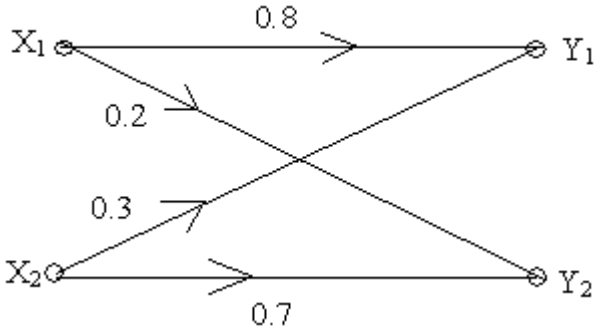
Q2 (a) What is entropy? Show that the entropy is maximum when all the messages are equi-probable.

Answer Page Number 16-17 of Textbook

Q2 (b) Find the mutual information and channel capacity of the channel shown in figure below. Given $p(x_1) = 0.6$ and $p(x_2) = 0.4$



Answer

Any $D = [P(Y/X)] = \begin{bmatrix} 0.8 & 0.2 \\ 0.3 & 0.7 \end{bmatrix}$

The joint probability matrix is obtained by multiplying the rows of $P(Y/X)$ by $P(x_1)$ and $P(x_2)$ respectively

$$[P(X,Y)] = \begin{bmatrix} 0.8 \times 0.6 & 0.2 \times 0.6 \\ 0.3 \times 0.4 & 0.7 \times 0.4 \end{bmatrix} = \begin{bmatrix} 0.48 & 0.12 \\ 0.12 & 0.28 \end{bmatrix}$$

$P(Y_1)$ and $P(Y_2)$ are obtained by summing the columns of $[P(X,Y)]$

$P(Y_1) = 0.48 + 0.12 = 0.6$

$P(Y_2) = 0.12 + 0.28 = 0.4$

The matrix $[P(X/Y)]$ is obtained by

$$[P(X/Y)] = \begin{bmatrix} 0.48/0.6 & 0.12/0.4 \\ 0.12/0.6 & 0.28/0.4 \end{bmatrix} = \begin{bmatrix} 0.8 & 0.3 \\ 0.2 & 0.7 \end{bmatrix}$$

$H(X)$ and $H(X/Y)$ can be found as

$$H(X) = -\sum_{j=1}^{2} P(x_j) \log P(x_j)$$

$$= -[0.6 \log 0.6 + 0.4 \log 0.4]$$

$$= 0.971 \text{ bit/message}$$

16 continue:-

$$H(X/Y) = -\sum_{j=1}^{2}\sum_{K=1}^{2} P(x_j, y_K) \log P(x_j/y_K)$$

$$= [0.48 \log 0.8 + 0.12 \log 0.3 + 0.12 \log 0.2 + 0.28 \log 0.7]$$

$$= 0.786 \text{ bit/message}$$

Hence

$$I(X,Y) = H(X) - H(X/Y) = 0.971 - 0.786$$

$$= 0.185 \text{ bit/message}$$

$P_{11} = 0.8$, $P_{12} = 0.2$, $P_{21} = 0.3$ and $P_{22} = 0.7$

Hence

$$\begin{bmatrix} 0.8 & 0.2 \\ 0.3 & 0.7 \end{bmatrix} \begin{bmatrix} Q_1 \\ Q_2 \end{bmatrix} = \begin{bmatrix} 0.8 \log 0.8 + 0.2 \log 0.2 \\ 0.3 \log 0.3 + 0.7 \log 0.7 \end{bmatrix}$$

Solving Q_1 and Q_2

$$Q_1 = -0.6568 \text{ and } Q_2 = -0.9764$$

Hence channel capacity

$$C = \log(2^{Q_1} + 2^{Q_2})$$

$$= \log(2^{-0.6568} + 2^{-0.9764})$$

$$= \log(0.633 + 0.513)$$

$$C = \log 1.146$$

$$\boxed{C = 0.2 \text{ bit/message}}$$ Ans

Q3 (a) Derive an expression for group delay and dispersion when signal propagates along the fiber.

Answer Page Number 134-136 of Textbook

Q3 (b) Explain with neat sketch generation of in – phase and quadrative sample from band pass signal g(t).

Answer Page Number 144 of Textbook

Q4 (a) What is QPSK? Discuss a correlation receiver (for QPSK) with the help of block diagram. What is bit probability error for QPSK.

Answer Page Number 284, 290 of Textbook

Q4 (b) Explain Intersymbol Interference (ISI). Write down the causes of ISI?

Answer Page Number 243 of Textbook

Q5 (a) Explain the differential PCM with the help of block diagrams.

Answer Page Number 201 of Textbook

Q5 (b) What do you mean by matched filter in digital communications and calculate the probability of error for matched filter?

Answer Page Number 87-88 of Textbook

Q6 (a) Explain the quantization error and derive an expression for maximum signal to noise ratio in PCM system that uses linear quantization.

Answer Page Number 192 of Textbook

Q6 (b) Discuss the methods of implementing adaptive equalizers.

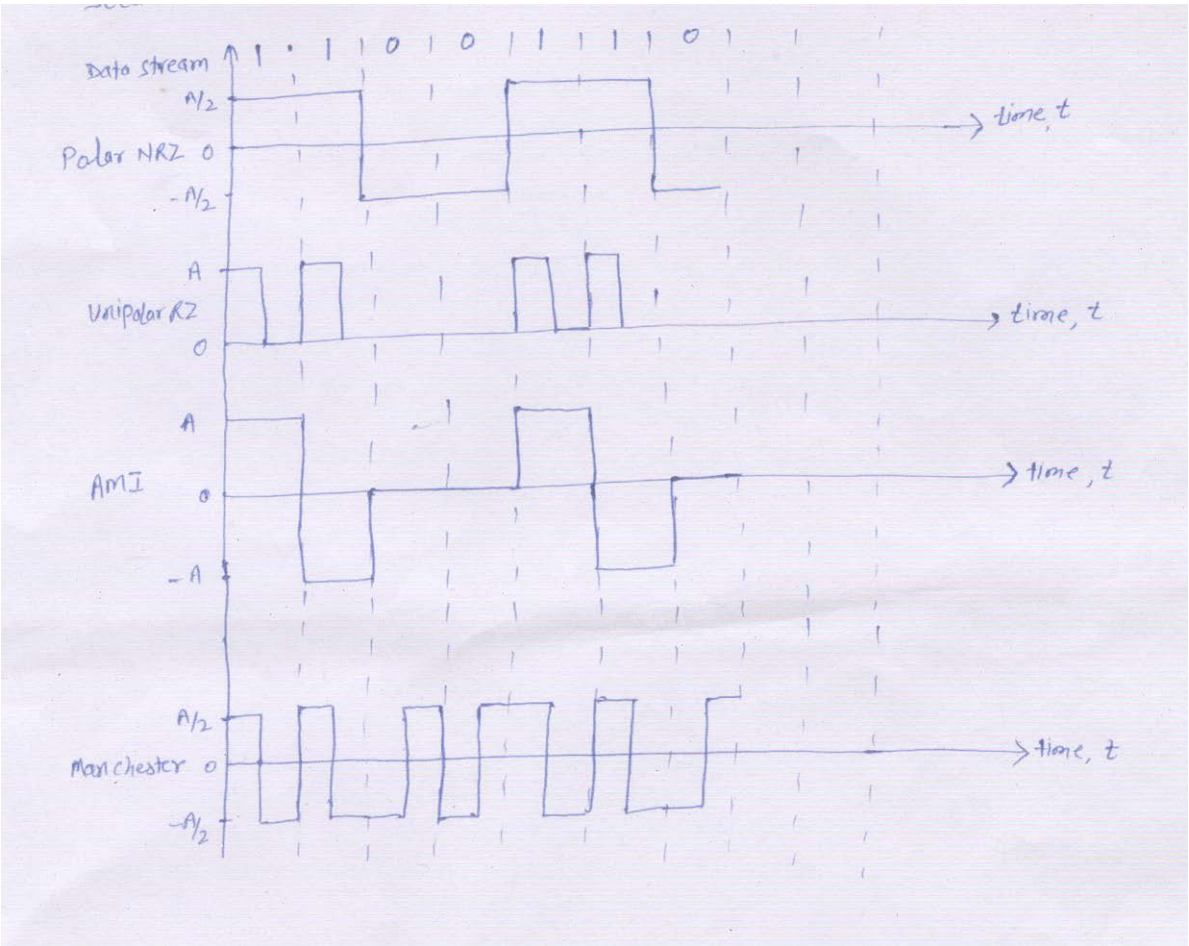
Answer Page Number 265 of Textbook

Q7 (a) Represent 1100110 in

(i) Polar NRZ **(ii) Unipolar NRZ**

(iii) AMI **(iv) Manchester**

Answer



Q7 (b) Explain the applications of spread-spectrum techniques.

Answer Page Number 467-469 of Textbook

Q8 (a) Draw block diagram of pseudorandom sequence generator and explain its working.

Answer Page Number 446-447of Textbook

Q8 (b) What is DSSS? Explain the transmitter and receiver of DSSS.

Answer Page Number 453-454 of Textbook

Q9 Write short notes on any <u>TWO</u>:

(i) Application of digital – modulation technique

(ii) Differential phase shift keying

(iii) Maximum – likelihood detector

Answer

(i) Page Number 349 of Textbook
(ii) Page Number 307 of Textbook
(iii) Page Number 101-102 of Textbook

Text Book

Digital Communication' by Siman Haykin