B.E. Sixth Semester (Electronics & Telecommunication., Electronics Engineering) (CGS)

10623 : Digital Communication : 6 XT 04

P. Pages : 4 | AU - 2777

Time : Three Hours | Max. Marks : 80

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Notes : 1. Answer **three** question from Section A and **three** question from Section B.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.
5. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) What is the need for line coding ? Hence explain the properties of line codes. **6**

b) Draw a well labelled block diagram of digital communication system. Hence explain its following blocks in details. **7**
i) Channel encoder and decoder.
ii) Source encoder and decoder
iii) Modulator and Demodulator.

OR

2. a) A randomly generated data stream consists of equiprobable binary symbols 0 and 1. It is encoded into a polar NRZ waveform with each binary symbol being defined as follows : **7**

$$s(t) = \begin{cases} \cos\left(\frac{\pi t}{T_b}\right) & ; \quad -\frac{T_b}{2} < t \le \frac{T_b}{2} \\ 0 & ; \quad \text{otherwise} \end{cases}$$

Sketch the waveform so generated, assuming that the data stream is 00101110. Hence, explain polar NRZ with its power spectral density curve.

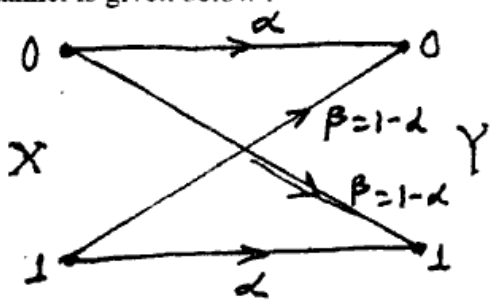
b) Explain high density bipolar order 3 encoding scheme along with its encoding rules. Hence find the HDB-3 code for the given input data stream 10100000110000110000000. **6**

3. a) Prove that the mutual information of a channel is related to the joint entropy of the channel input and channel output by **7**
$I(X ; Y) = H(X) + H(Y) - H(X, Y)$
where $H(X, Y)$ is the joint entropy.

b) An analog signal has a 4 kHz bandwidth. The signal is sampled at 2.5 times the Nyquist rate and each sample is quantized into one of the 256 equally likely levels. Assume that successive sample are statistically independent. **6**
i) What is the information rate of this source ?
ii) Can the output of this source transmitted without errors over a Gaussian channel with a bandwidth of 50 kHz and S/N ratio of 23 dB ?
iii) What are the bandwidth requirements of this analog channel for transmitting the output of the source without errors, if the S/N is 10 dB ?

OR

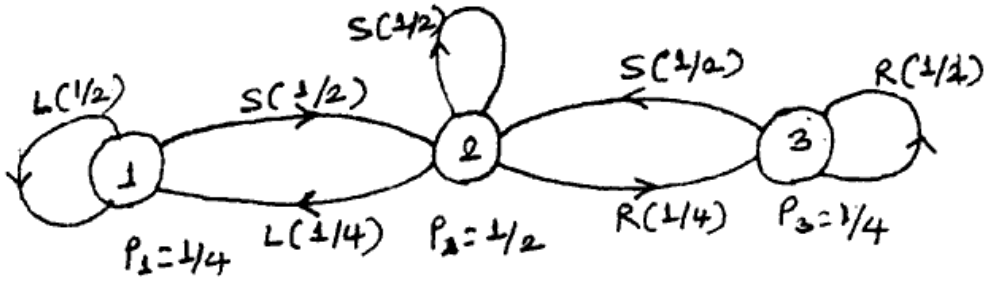
4. a) The binary symmetric channel is given below : 6



Assume r_s = 1000 symbols / sec.

Find H(X), H(Y), H(X|Y) and H(Y|X) when $P(X=0)=\frac{1}{3}$, $P(X=1)=\frac{2}{3}$ and $\alpha = 0.6$.

b) Design a source encoder using Shannon's Encoding Algorithm for a block size of two symbols and variable length code words. Calculate the average number of bits per symbol $\hat{H}_2$ used by the encoder for the given markoff source. Also, verify that $\hat{H}_2 \leq G_2 + \frac{1}{2}$, where G_2 is average information content per symbol. 7



5. a) A bit stream 11011100101 is to be transmitted using DPSK. Determine the encoded sequence and the transmitted phase sequence. Show that the phase comparison scheme can be used for demodulating the DPSK modulated signal, Also, draw a well labelled block diagram of DPSK modulator and demodulator & list the disadvantages of DPSK scheme. 8

b) Compare the following digital modulation schemes in terms of Bandwidth requirements power requirements immunity to channel impairments and equipment complexity. 6

i) Non coherent ASK
ii) Coherent BPSK
iii) Coherent BFSK.

OR

6. a) With the help of neat and well labelled block diagram, explain the working of QPSK transmitter along with necessary mathematical expression at the output of each block. For the given QPSK modulator contract the truth table for input versus QPSK output phase, phasor diagram and constellation diagram. 8

b) Derive the transfer function for the optimum filter and hence determine the minimum probability of error. 6

SECTION - B

7. a) A binary data stream 0011101000 is applied as an input to a modified duobinary encoder with precoding construct a modified duobinary encoder with precoder to code the input data stream. Also decode the encoder output to obtain the original datastream. **7**

b) Explain the operation of clock recovery network consisting of voltage controlled oscillator and phase comparator. **6**

OR

8. a) What is the need for equalization ? Explain a three tap adaptive equalizer with the help of well labelled block diagram. How initial equalization is achieved in adaptive equalizers ? **7**

b) What do you mean by signal design for zero ISI ? Hence derive the condition for shaping Ideal Nyquist pulse for Distortionless Baseband data transmission. **6**

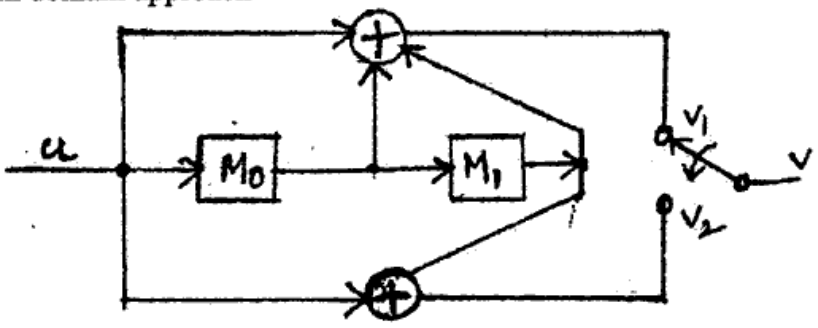
9. Consider a (6, 3) linear block code defined by the generator matrix **14**

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

i) Determine if the code is Hamming code, find the parity check matrix H of the code in systematic form.
ii) Find the encoding table of the linear block code.
iii) What is the minimum hamming distance d_{min} of the code. How many errors can the code detect and correct.
iv) Draw the hardware encoder diagram.
v) Find the decoding table for the linear block code.
vi) Draw the hardware syndrome generator diagram.
vii) Suppose code C = [1 1 1 0 0 0] is sent and code R = [1 1 1 0 0 1] is received show how the code can correct this error.

OR

10. a) For the convolution code encoder shown below determine the output using time domain and transform domain approach **7**



where u = (1 1 1 0 1)
Hence determine the state diagram for the above convolution code encoder.

b) Consider the generator polynomial for a(7, 3) cyclic code defined by **7**

$g(p) = p^4 + p^3 + p^2 + 1$

i) Find the encoding table for the cyclic code.
ii) What is minimum distance, d_{min}, of the code. Hence determine its error detection and correction capability.
iii) Develop error pattern for single bit error.

11. a) The following table describes the operation of FHSS system for one complete period of PN sequence.

Time	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
I/P Data	0	1	1	1	1	1	1	0	0	0	1	0	0	1	1	1	1	0	1	0
Frequency	f_1		f_3		f_{23}		f_{22}		f_8		f_{10}		f_1		f_3		f_2		f_2	
PN seq.	001				110				011				001				001			

i) What is the period of the PN sequence, in terms of bits in the sequence?
ii) What is the number of bits per symbol?
iii) What form of FSK is used in this example?
iv) What is length of PN sequence per hop?
v) Is this a slow or fast FHSS?
vi) What is the total number of possible carrier frequencies?

b) With the help of well labelled block diagram, explain the frequency hopping spread spectrum (FHSS) system. Hence, differentiate between slow FHSS and fast FHSS. 7

OR

12. a) A ground to - satellite link is to operate at a data rate of 12 kbps with a ground station antenna of 90 feet and transmit power of 12 KW. It employs 12 mpbs DSSS code. The receiver E_b/J_0 required for reliable communication is 18 dB. A jammer with 120 feet antenna intends to disrupt the link. Assume equal space and propagation losses and that receiver noise in negligible, find : 6

i) Processing gain of the spread spectrum system.
ii) Jammer power required to disrupt the communication system. [Note : E_b denotes average bit energy and J_0 denotes Jamming power spectral density]

b) Explain the process of PN sequence generation using suitable example. Hence explain, any three properties of PN sequence. 7

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