Sample Question Bank

Digital Communication System-18EC5DCDCS

MODULE-1

1. Define the following with respect to information theory i) Entropy ii) Rate of Information iii) Self information.
2. Justify that the information content of a message is of a logarithmic function of its probability of emission.
3. Develop an expression for average information content (entropy) of long independent messages.
4. A binary source emitting an independent sequence of 0's and 1's with probabilities p and (1-p) respectively. Plot the entropy of the source.
5. List the properties of Entropy.
6. Illuminate on the concept of amount of information associated with message.
7. A code is composed of dots and dashes. Assume that the dash is 3 times as long as the dot and has one-third the probability of occurrence. (i) Assess the information in dot and that in a dash; (ii) Estimate the average information in dot-dash code; and (iii) Assume that a dot lasts for 1 ms and this same time interval is allowed between symbols. Examine the average rate of information of transmission.
8. A source has 2 symbols alpha and beta. The duration of alpha is 0.2 sec, beta duration is 3 times of alpha duration. The probability of alpha is twice that of beta and time between each symbol is 0.2 sec. Calculate the information rate of the source.
9. An An analog signal band limited to 8 KHz is sampled at twice the Nyquist rate and then quantized into 16 level, out of which 4 levels occur with a probability of 1/4 each 4 with 1/8 each and remaining 8 levels with probability 1/16 each respectively. Determine the information rate associated with the analog signal.
10. A card is drawn from a deck of playing cards.
    i) You are informed that the card you draw is spade. How much information did you receive in bits?
    ii) How much information did you receive if you are told that the card you drew is an ace?
    iii) How much information did you receive if you are told that the card you drew is an ace of spades?
    iv) Is the information content of the message "ace of spades" the sum of the information contents of the messages "spade" and "ace"?

11. A black and white TV picture consists of 525 lines of picture information. Assume that each consists of 525 picture elements and that each element can have 256 brightness levels. Pictures are repeated the rate of 30/sec. Estimate the average rate of information conveyed by a TV set to a viewer.
12. A zero memory source has a source alphabet S= {S1, S2, S3} with P= {1/2, 1/4, 1/4}. Estimate the entropy of the source.
13. Apply Shannon's binary Encoding procedure to the following set of messages and obtain the code efficiency and redundancy for 1/8, 1/16, 3/16, 1/4, 3/8
14. Consider a discrete memoryless source with alphabets {S1,S2,S3,S4,S5,S6} with {0.4,0.2,0.2,0.1,0.07,0.03}. Apply Huffman algorithm to construct Binary Code and Ternary codes for the source by placing the composite symbols as low as possible. Also find efficiency in each case.
15. Given the messages s_1, s_2, s_3 and s_4 with respective probabilities of 0.4, 0.3, 0.2 and 0.1, construct a binary code by applying Huffman encoding procedure. Determine the efficiency and redundancy of the code so formed.
16. Consider a Zero memory source with S=[S1,S2,S3,S4,S5,S6,S7] and Probabilities

    P = [0.4, 0.2, 0.1, 0.1, 0.1, 0.05, 0.05]

    i. Construct a binary Huffman code by placing the composite symbol as low as possible.
    ii. Repeat (i) by moving a composite symbol as high as possible.
    iii. In each of the cases (i) and case(ii) above,
        - Compute the variances of the word lengths and comment on the result.
        - Find Efficiency and Redundancy.
    iv. Considering Case(ii) table,
        - Write the code tree and decode the message 01110110011000100……

    Determine probabilities of 0's and 1's.
17. Consider a Zero memory source with S=[S1,S2,S3,S4,S5] and Probabilities

    P = [0.4, 0.2, 0.2, 0.1, 0.1]

    i. Construct a binary Huffman code by placing the composite symbol as low as possible.
    ii. Repeat (i) by moving a composite symbol as high as possible.
    iii. In each of the cases (i) and (ii) above,
        - Compute the variances of the word lengths and comment on the result.
        - Find Efficiency and Redundancy.
    iv. Considering case (ii) table,
        - Write the code tree and decode the message 1000011010….
        - Determine probabilities of 0's and 1's.
18. Design a trinary source code for the source shown using Huffman's coding procedure $S = \{s_1, s_2, s_3, s_4, s_5, s_6\}$,$P=\left\{\frac{1}{3}\ \frac{1}{4}\ \frac{1}{8}\ \frac{1}{8}\ \frac{1}{12}\ \frac{1}{12}\right\}$, X={0 1 2}. Also determine efficiency and redundancy.

19. Consider a source with 8 alphabet A to H with respective probabilities of 0.22, 0.20, 0.18, 0.15, 0.10, 0.08, 0.05, 0.02.
    i] Construct a binary compact code and determine the code efficiency.
    ii] Construct a ternary compact code and determine efficiency of the code
    iii] Construct a quaternary compact code and determine the code efficiency.
    iv] Compare and comment on the result.
    v] Construct the code trees for all three cases and decode the messages using appropriate code trees
        a) 0101001000001101011001…
        b) 12111011020012002 ….
        c) 031132020300100231 …..
20. A binary symmetric channel has the following noise matrix with source probabilities $P(x_1) = 2/3$, $P(x_2) = 1/3$. Evaluate H(x), H(y), H(x,y), H(x/y), H(y/x), I(x, y), C, η_{ch}

$$P\left(\frac{y}{x}\right) = \begin{bmatrix} \frac{3}{4} & \mathbf{\frac{1}{4}} \\ \mathbf{\frac{1}{4}} & \mathbf{\frac{3}{4}} \end{bmatrix}$$

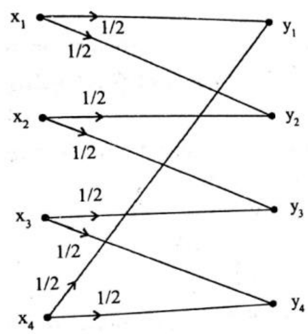
21. Define i) Mutual Information ii) Channel Capacity.
22. Analyze binary symmetric channel. Develop an expression for channel capacity
23. For the channel matrix shown below, estimate the Capacity of the channel if r_s =1000 symbols/sec

$$P\left(\frac{y}{x}\right) = \begin{bmatrix} 0.4 & 0.3 & 0.2 & 0.1 \\ 0.4 & 0.1 & 0.3 & 0.2 \\ 0.1 & 0.2 & 0.4 & 0.3 \end{bmatrix}$$

24. A transmitter transmits 5 symbols with probabilities with probabilities 0.2, 0.3, 0.2, 0.1, 0.2.
    Determine H(X), H(Y), H(X, Y), H (Y/X) for the Channel matrix P(Y/X) as shown below.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 1/4 & 3/4 & 0 & 0 \\ 0 & 1/3 & 2/3 & 0 \\ 0 & 0 & 1/3 & 2/3 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

25. Determine the Channel capacity shown in fig



26. For the channel matrix shown, evaluate the channel capacity

$$P(b_j/a_i) = \begin{array}{c} \\ a_1 \\ a_2 \\ a_3 \end{array} \begin{array}{c} \begin{array}{ccc} b_1 & b_2 & b_3 \end{array} \\ \begin{bmatrix} 1/2 & 1/3 & 1/6 \\ 1/3 & 1/6 & 1/2 \\ 1/6 & 1/2 & 1/3 \end{bmatrix} \end{array}$$

27. For the JPM given below, compute H(X), H(Y), H(X,Y), H(X/Y), H(Y/X) and I(X,Y).

$$P(X, Y) = \begin{matrix} 0.05 & 0 & 0.20 & 0.05 \\ 0 & 0.10 & 0.10 & 0 \\ 0 & 0 & 0.20 & 0.10 \\ 0.05 & 0.05 & 0 & 0.10 \end{matrix}$$

28. State Shannon- Hartley law. Derive an expression for the upper limit on Channel capacity as bandwidth tends to ∞.
29. State Shannon-Hartley law for channel capacity and illustrate its implication.

30. A B/W TV picture may be viewed as consisting of approximately 3 x10^5 elements, each one of which may occupy 10 distinct brightness levels with equal probability. Assuming the rate of transmission as 30 picture frames/sec and an SNR of 30dB, estimate minimum bandwidth required to support the transmission of the resultant video signal.

31. A CRT terminal is used to enter alphanumeric data into a computer, the CRT is connected through a voice grade telephone line having usable bandwidth of 3KHz and an output S/N of 10 dB. Assume that the terminal has 128 characters and data is sent in an independent manner with equal probability.
    i. Check the average information per character.
    ii. Determine capacity of the channel.
    iii. Check the maximum rate at which data can be sent from terminal to the computer without error.
32. What is Shannon's limit? Derive expression for Shannon's limit for (E_b/n_0) parameter illustrating with Bandwidth – efficiency diagram.
33. An analog signal having bandwidth of 5 KHz is sampled at twice the Nyquist rate with each sample quantized into one of 128 equally likely levels.

a. Assess the information rate of this source.

b. Is it possible for this source to transmit without error over an AWGN Channel with Bandwidth of 12 KHz and SNR of 22dB?

c. Estimate the SNR required for error free transmission for part (a)

d. Determine the Bandwidth required for AWGN channel for error free transmission of this source if SNR happens to be 22dB.

Module-2:

1. For the given (6, 3) systematic linear block code, the parity matrix P is given by

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

i] Generate all possible code words and construct the encoding circuit.

ii] If the received code vector is R=[110010]. Detect and correct the single error that has occurred due to noise.

2. In a linear block code (6,3) the syndrome is given by

S1=r1+r3+r4   S2=r2+r3+r5   S3=r1+r2+r6

a**]** If the received code vector is R = [110010], Detect and correct the single error that has occurred due to noise.

b] Construct G and H Matrices.

3. In a linear block code (7,4) the syndrome is given by

S1=r1+r2+r3+r5   S2=r1+r2+r4+r6   S3=r1+r3+r4+r7

a**]** Construct G and H Matrices.

b] A single error has occurred in the received vector R= [1011100].Detect and correct error.

4. A (6,3)linear block code has the following check bits, $C_4=d_1+d_2$, $C_5=d_1+d_3$, $C_6=d_2+d_3$

i) Construct G & H matrices

5. For a systematic (7,4) linear block code, the parity matrix is given by

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

a) Generate all possible valid code vectors

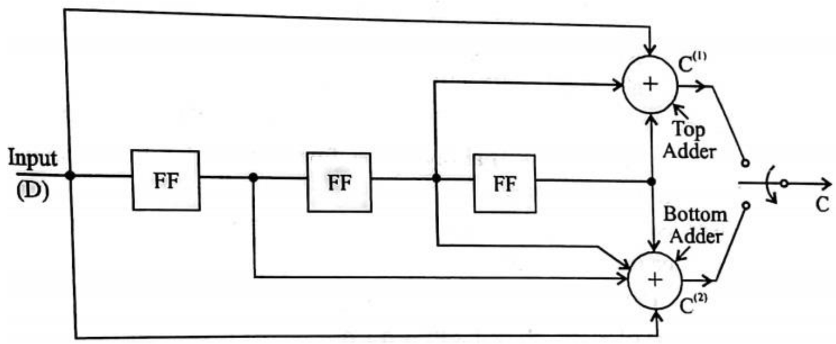
b) A single error has occurred in the received vector **R=[1010000].** Detect and correct error.

6. The generator polynomial for a (7, 4) binary cyclic code is $\mathbf{g(x) = 1 + x + x^3}$

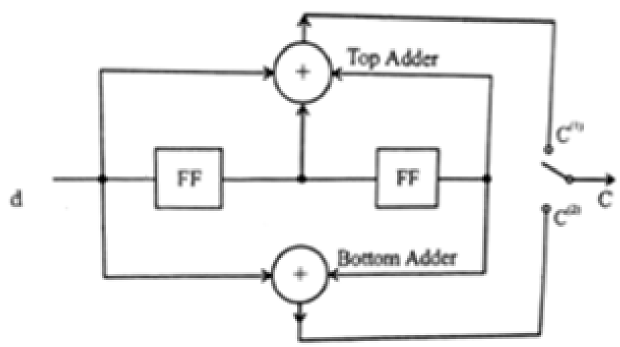
Find the code vector in Non-systematic and Systematic form for the following messages (i) 1011 (ii) 1001

7. The generator polynomial for (15,7) cyclic code is $g(x)=1+x^4+x^6+x^7+x^8$. Find the code vector in systematic form of message $D(x) = x^2+x^3+x^4$ suffer transmission error. Find the syndrome of V(x).

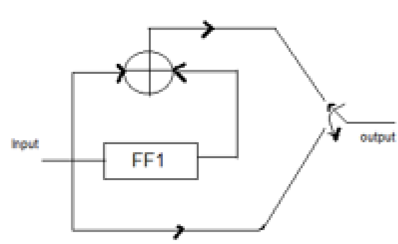
8. Design an encoder for the (7,4) binary cyclic code generated by g(x) = 1 + x + x3 and check its operation using the message vectors 1001 and 1011
9. Consider a (15,11) Cyclic code generated using **$g(x) = 1 + x + x^4$**
   i. Design a feedback register Encoder for the same.
   ii. Generate a code vector for the message **[11001101011]** by listing the status of shift register.
10. For a **(7,4)** cyclic code, the **$g(x) = 1 + x + x^3$**,
   i. Build the syndrome calculation circuit
   ii. Determine the syndrome for the following received vector with single error **[1110101]**
11. Consider a (15,11) Cyclic code generated using **$g(x) = 1 + x + x^4$**
   i. Device a feedback register Encoder for the same.
   ii. Illustrate the encoding procedure with the message vector **[10010110111]** by listing the status of shift registers.
12. A **(15, 5)** linear cyclic code has generator polynomial **$g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$**
   i. Construct the block diagram of Encoder.
   ii. Determine the code polynomial for message polynomial **$D(x) = 1 + x^2 + x^4$** using encoder diagram
13. For a **(7,4)** cyclic code, the received vector is **[1110101]** and the **$g(x) = 1 + x + x^3$**. Build the syndrome calculation circuit and correct the single error in the received vector**.**
14. A (15, 5) binary cyclic code has a generator polynomial $g(x)=1+x+x^2+x^4+x^5+x^8+x^{10}$.
   i) Construct the block diagram of encoder and Syndrome Calculator for this code.
   ii) Estimate the code polynomial for message polynomial $D(x) = 1+x^2+x^4$ in systematic form.
   iii) Is $V(x) = 1+x^4+x^6+x^8+x^{14}$ a code polynomial?
15. A (15,5) linear cyclic code has a generator polynomial g(x) = 1+x+x2+x4+x5+x8+x10
   (a) Draw the block diagram of an encoder and syndrome calculator for this code.
   (b) Find the code polynomial for the message polynomial D(x)= 1+x2+x4 in systematic form.
   (c) Is V(x) = 1+x4+x6+x8+x14 a code polynomial.
16. The generator polynomial for a (15,7) cyclic code is g(x) = 1+x4+x6+x7+x8
   (a) Find the code vector in the systematic form for the message D(x) = x2+x3+x4.
   (b) Assume the first and last bit of the code vector V(x) for D(x) = x2+x3+x4 suffer the transmission errors. Find the syndrome of V(x).
17. Consider a (3, 1, 2) Convolution Encoder with $g^{(1)}=110$, $g^{(2)}=101$ and $g^{(3)}=111$.
   Build the Encoder Block diagram, Construct the Generator Matrix and find code vector Corresponding to information sequence D=111101 using time domain approach**.**
18. Consider a (n, k, m) = (2, 1, 3) convolutional encoder as shown in the fig. Generate the codes using time domain and transfer domain approach.



19. Consider the (3,1,2) convolutional code with $g^{(1)}=(1\ 1\ 0)$,$g^{(2)}=(1\ 0\ 1)$ and $g^{(3)}=(1\ 1\ 1)$.
    i) Determine the constraint length, rate efficiency.
    ii) Construct the generator matrix.
    iii) Generate the codeword for the message sequence (1 1 1 0 1) using time domain approach.
20. Consider the (3,1,2) convolutional code with $g^{(1)}=(1\ 1\ 0)$,$g^{(2)}=(1\ 0\ 1)$ and $g^{(3)}=(1\ 1\ 1)$.
    i) Construct the generator matrix.
    ii) Generate the code word for the message sequence (1 1 1 0 1) using time domain and Transfer domain approach.
21. For the convolution encoder shown in fig , draw the state table, state transition table, State diagram and corresponding code tree. Using the code tree, assess the encoded sequence for the message d= 10111.

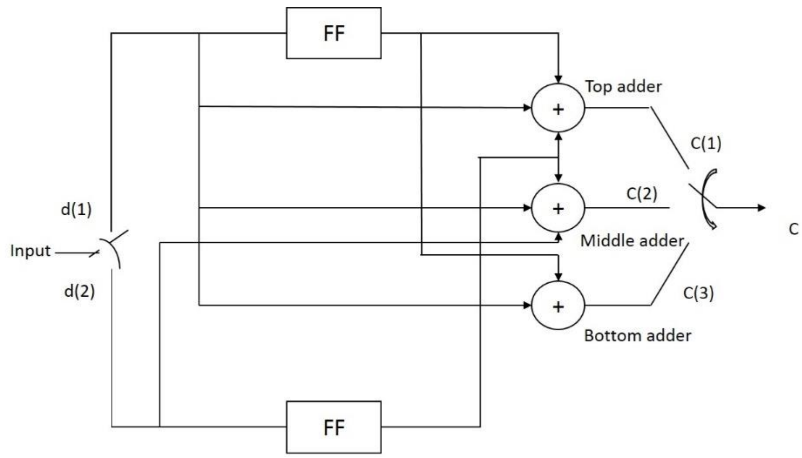


1. For the convolution encoder shown in fig(a), construct the i) state table ii) state diagram iii) State transition table iv) the corresponding code tree v) Using the code tree, Estimate the encoded sequence for the message 10111. Validate the output using time domain approach and transfer domain approach.

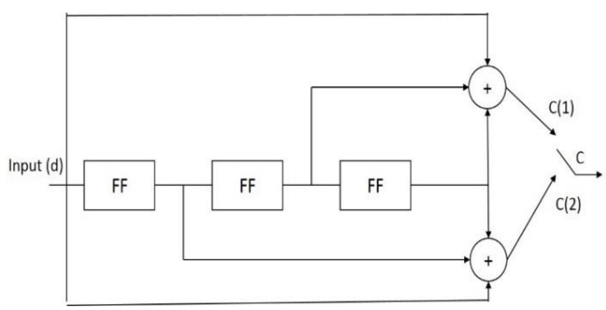


fig(a)

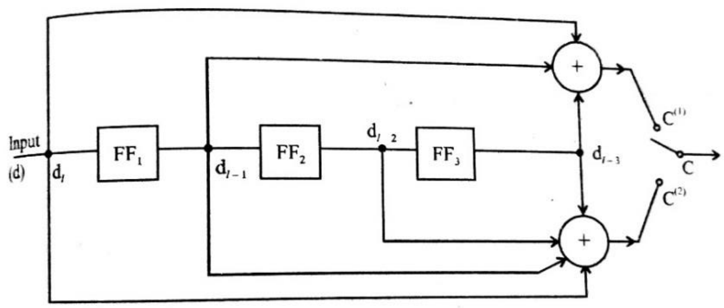
2. For the (3,2,1) encoder shown in the figure, find code word C for input sequence of $d^{(1)}$ =101 and $d^{(2)}$= 110 using
   (a) Time domain approach (using generator matrix)
   (b) Transform domain approach by constructing transfer function matrix.



22. Figure shows a (2,1,3) convolutional encoder
   (a) Draw the state diagram
   (b) Draw the code tree
   (c) Find the encoder output produced by the message sequence 11101 by traversing through code tree.

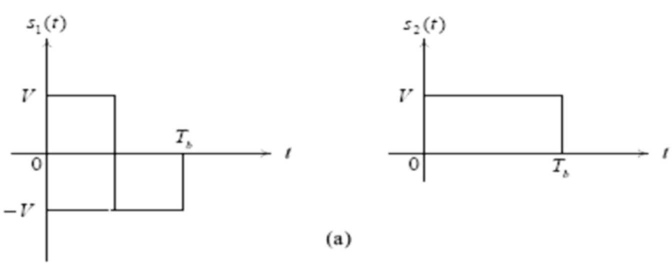


23. For the convolutional encoder shown in the figure
   (a) Draw state table
   (b) Draw state transition table
   (c) Draw state diagram
   (d) Find encoder output for the message sequence 10011 by traversing through the state diagram



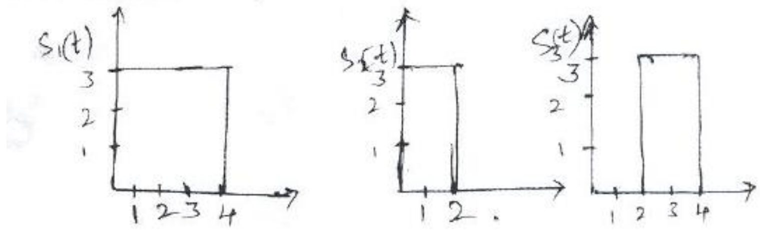
Module-3:

1. Explain with equations, how you determine basis functions for a given set of signals using Gram Schmidt orthogonalization procedure.
2. Given the signals shown below, find basis functions using GSO procedure. Draw signal space diagram and mark the signal points

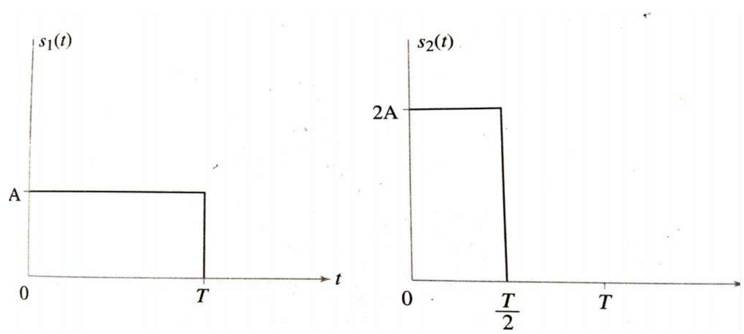


(a)

3. Given two signals $s_1(t)$=A cos(w_1t) and $s_2(t)$=A cos(w_2t), find basis functions and mark signals in signal space diagram
4. What is a matched filter? Explain the functioning of detector part of matched filter with equations.
5. What is a correlation receiver? Explain the functioning of correlation receiver with equations.
6. What are the properties of matched filter? Prove them
7. Explain the correlation receiver using product integrator and matched filter.
8. Three signals $s_1(t)$,$s_2(t)$and $s_3(t)$ are shown in fig. Apply Gram Schmidt procedure to obtain an orthonormal basis for the signals. Express signals $s_1(t)$,$s_2(t)$and $s_3(t)$ in terms of orthonormal basis function.



9. Using GS orthogonalization procedure, find set of orthonormal basis functions for any three signals.
10. Explain the importance of geometric interpretation of signals.
11. Explain the conceptual model of digital communication system.
12. Two functions $s_1(t)$ and $s_2(t)$ are given in fig. The interval in 0<t<T sec. Using Gram Schmidt procedure, express these functions in terms of orthonormal functions. Also sketch $\phi_1(t)$ and $\phi_2(t)$.



13. Suppose $s_1(t)$,$s_2(t)$and $s_3(t)$ are represented with reference to two basis functions $\phi_1(t)$ and $\phi_2(t)$. The coordinators of these signals are

    S_1=(s11,s12)=(3,0)

    S_2=(s21,s22)=(-2,3)

    S_3=(s31,s32)=(-3,-3)

    Draw the constellation diagram and express $s_1(t)$,$s_2(t)$and $s_3(t)$ as a linear combinations of the basis functions.
14. (i) Check whether the signals $\phi_1(t)$ and $\phi_2(t)$ sketched in fig (a). are orthogonal. (ii) Obtain corresponding functions. (iii) Express the given signals $s_1(t)$,$s_2(t)$and $s_3(t)$ shown in fig (b). in terms of $\phi_1(t)$ and $\phi_2(t)$.

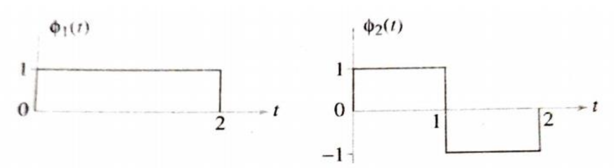


Fig. (a)

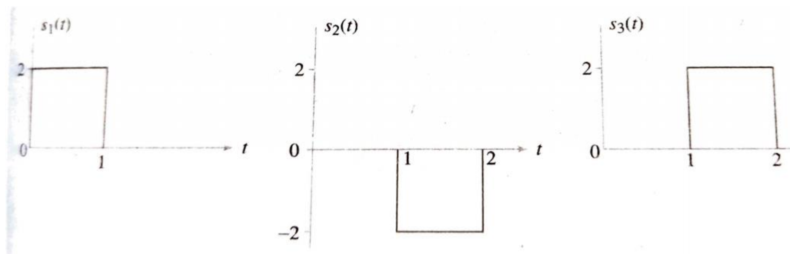
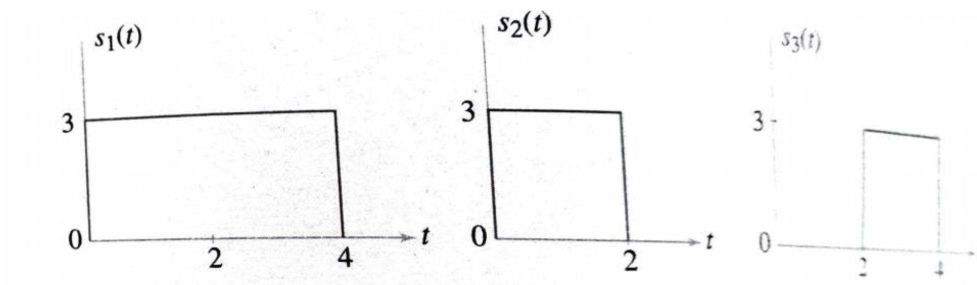


Fig. (b)

15. Three signals s1(t),s2(t)and s3(t) are shown in fig. Apply Gram Schmidt procedure to obtain an orthonormal basis for the signals. Express signals s_1(t),s_2(t)and s_3(t) in terms of orthonormal basis function. Also give the signal constellation diagram.



16. Check whether the signals ϕ_1(t) and ϕ_2(t) sketched in fig (a). are orthogonal. Express the given signals s_1(t),s_2(t)and s_3(t) shown in fig (b). in terms of ϕ_1(t) and ϕ_2(t).

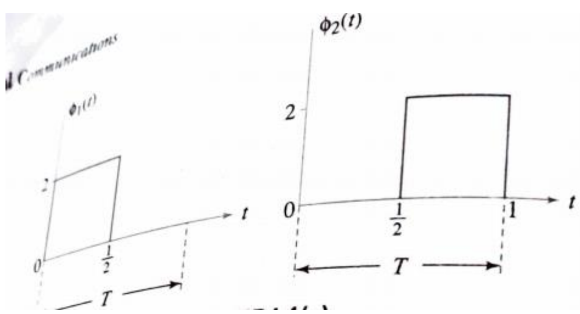


Fig (a)

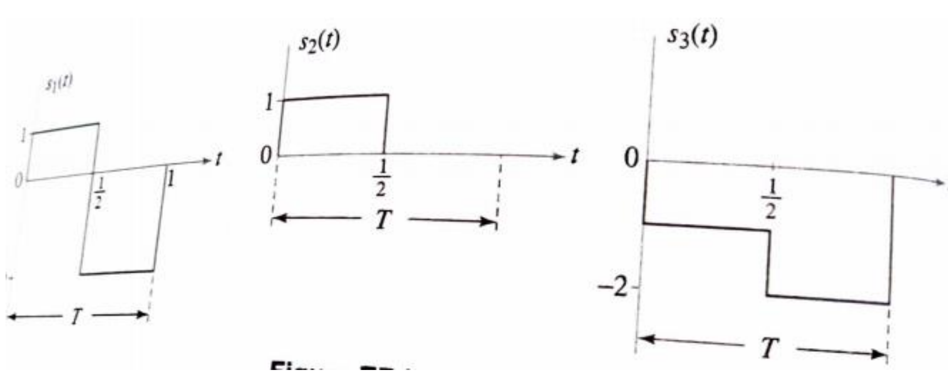
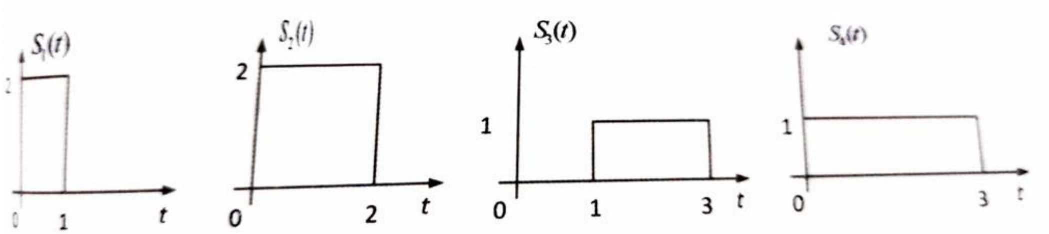


Fig (b)

17. Using the Gram-Schmidt orthogonalization procedure, find a set of orthonormal basis functions to represents the signals $S_1(t)$, $S_2(t)$, $S_3(t)$ and $S_4(t)$ shown in the figure below. Express each of these signals in terms of the set of basis functions.

18. 

Module-4

1. Obtain an expression for the average probability of symbol error for coherent BPSK signal.
2. With a block diagram, explain the coherent BFSK transmitter and receiver. Indicate its signal space diagram with relevant equations.
3. Binary data are transmitted over a microwave link at the rate of 10^6 bps and PSD of the noise at the receiver input is 10^{-10}W/Hz. Find the average carrier power required to maintain an average probability of error $Pe \leq 10^{-4}$ for coherent binary FSK. What is the required channel bandwidth ? [Consider erfc (2.7) =2 x 10^{-4}].
4. Explain the generation and detection of non-coherent DPSK wave with block diagrams. Also write the equation for average probability of error. . Illustrate the generation of differentially encoded scheme for the binary data 1100100010 with initial bit as 0 and represent waveforms of each stage.
5. What is meant by eye pattern in the data transmission system and explain.

6. Explain adaptive equalization for data transmission
7. Obtain an expression for the average probability of symbol error for coherent BFSK signal.
8. With the block diagram of QPSK transmitter and receiver, explain generation and detection of QPSK Wave. Write the signal space diagram for the QPSK.
9. Given the binary data 10010011, draw the BPSK and DPSK signals.

10. Sketch QPSK waveform for binary sequence 110010111.
11. An FSK system transmits binary data at a rate of 10^6 bits per second. Assuming channel noise is AWGN with zero mean and PSD of 10^{-20} Watts/Hz. Determine the average probability of error. Assume coherent detection and amplitude of received sinusoidal signal for both 1 and 0 to be 1.2 microvolt.
12. A binary data stream $\{b_k\}$={010010011} is to be transmitted using DPSK. Choose d_{-1}=0 and determine (a) the differentially encoded sequence $\{d_k\}$, (b) phase of the transmitted DPSK signal, (c) polarity of the integrator output at $t=T_b$, of the DPSK receiver, (d) decision rule and (e) detected binary sequence.
13. A binary FSK system transmit data at a rate of 2MBPS (mega per second) over an AWGN channel. The noise is zero mean with PSD $N_0/2=10^{-20}$ W/Hz. The amplitude of received signal in the absence of noise is 1 microvolt. Determine the average probability of error for coherent detection of FSK.
14. The binary data is transmitted over an AWGN channel using binary phase shift keying at a rate of 1MBPS. It is desired to have average probability of error $Pe \leq 10^{-4}$. Noise power spectral density is $N_0/2=10^{-12}$ W/Hz. Determine the average carrier power required at the receiver input, if the detector is of coherent type. Take erfc(3.5)=0.00025.
15. In a QPSK modulation scheme, the input binary sequence $\{b_i\}$ is {11001011101}. The bit interval is Tb. Give the demultiplexed sequence $\{b_{ei}\}$ and $\{b_{oi}\}$. Assuming NRZ polar waveform, sketch the sequence $\{b_i\}$, $\{b_{ei}\}$ and $\{b_{oi}\}$.
16. Sketch the inphase and quadrature components of a QPSK signal for the binary sequence 110010111. Assume carrier frequency fc to be equal to $1/T_b$. Choose any convenient basis functions.

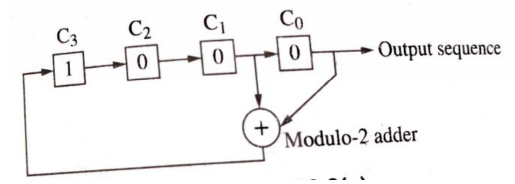
Module-5

1. Define processing gain and jamming margin
2. With neat block diagram explain Frequency hop spread spectrum transmitter and receiver. Compare Slow and fast frequency hopping.
3. Generate the maximum length sequence for 3 stage shift register with linear feedback with initial value 100. Verify the properties of ML sequence and determine the period.
4. Discuss briefly the applications of spread spectrum technique of CDMA and Multipath Suppression.

5. What is spread spectrum technique. Explain the principle of direct sequence spread spectrum system transmitter and receiver.

6. The DSSS communication system has following parameters:
   Data sequence bit duration Tb=4.095ms, PN chip duration Tc=1 microseconds.
   Eb/No=10 for average probability of error less than 10^{-5}. Calculate processing gain, Spread factor and Jamming margin and express in db.
7. What is the role of PN sequence in spread spectrum communication?
   Compare DSSS and FHSS.
8. Explain PN sequence and its properties.
9. Check the maximum length properties for the sequence 11001010.
10. State and prove balance property, run property and autocorrelation property.
11. In a direct sequence spread spectrum modulation scheme, a 14-stage linear feedback shift register is used to generate the PN code sequence. Find (a) the period of the code sequence and (b) processing gain.
12. In a DSSS modulation, it is required to have a jamming margin greater than 26 dB. The ration Eb/No is set at 10. Determine the minimum processing gain and the minimum number of stages required to generate the maximum length sequence.
13. A PN sequence is generated using linear feedback shift register with number of stages equal to 10. The chip rate is 107 per sec. Find the following. (a) PN sequence length (b) Chi duration of the PN sequence. (c) Period of the PN sequence.
14. A slow FH/MFSK system has the following parameters:
    The number of bits/MFSK symbol=4
    The number of MFSK symbols per hop=6
    Calculate the processing gain of the system.
15. A PN sequence is generated using 4-stage linear feedback shift register as shown in fig. with initial condition (C3C2C1C0)=(1000). This sequence is used in a slow FH/MFSK system. The FH/MFSK signal has the following parameters:
    Number of bits per MFSK Symbol: K=2
    Number of MFSK tones : M=4.
    Length of PN Segment per hop : k=3,

Total number of frequency hops : 8



Determine the following:

a) Period of the PN sequence.

b) PN sequence for one periodic length.

c) Illustrate the variation of the frequency of FH/MFSK signal for one complete period of the PN sequence. Assume that the carrier hops to a new frequency after transmitting two MFSK symbols or four information bits. Assume binary data sequence to be 10001101000111111001.

d) Sketch the variation of dehopped frequency with time.

16. In a fast FH/MFSK signal has the following parameters:

Number of bits per MFSK Symbol: K=2

Number of MFSK tones : M=4.

Length of PN Segment per hop : k=3,

Total number of frequency hops : 8

Number of hops per MFSK symbol=2

Period of PN sequence:L=15.

i) Determine the relation between bit rate and chip rate

ii) Sketch the variation of frequency of the transmitted signal with time. Assume binary data sequence to be 01101100 and one period of PN sequence is 111100010011010.

iii) Sketch the dehopped MFSK signal.

17. Briefly discuss the idealized model of baseband spread-spectrum system, along with necessary equations and waveforms. Extend the concept to achieve DSSS.

18. What is spread spectrum? What is the role of PN code in spread spectrum?

19. Explain with block diagram the model of direct sequence spread binary PSK system.

20. Explain the principle of frequency hopping spread spectrum system.

21. Mention the advantages of spread spectrum communication system.

22. Draw the 4 stage linear feedback shift register with 1st and 4th state is connected to Modu1o-2 adder. Output of Modu1o-2 is connected to 1st stage input. Find the output PN sequence and write the autocorrelation function with initial state 1000.