05/12/2024 (FN)

Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, NOV / DEC 2024

B.E. Electronics & Communication Engineering

V Semester

EC5502 DIGITAL COMMUNICATION

(Regulation 2019)

Time: 3hrs Max.Marks: 100

CO1	Capable of configuring Source coding schemes
CO2	To be able to design Channel coding schemes
CO3	To be able to design base band signalling scheme and analyze their performance
CO4	To be able to design various Bandpass signalling schemes and compare their performance
CO5	Capable of designing synchronization schemes
CO6	Capable of designing spread spectrum systems

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

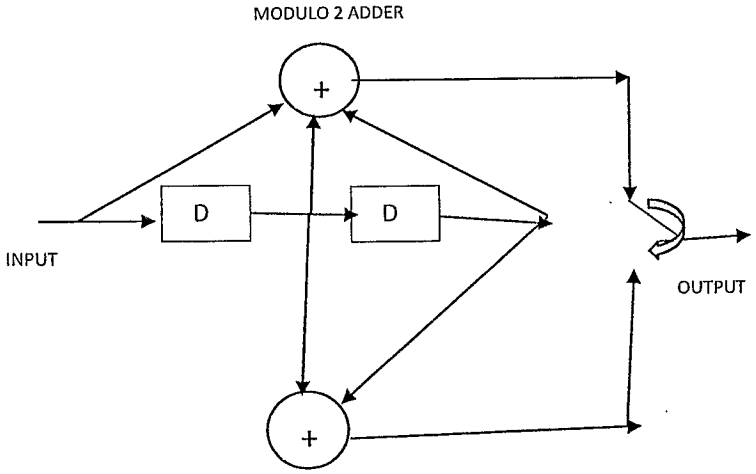
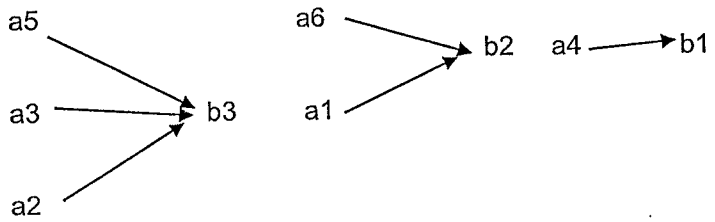
PART- A (10x2=20Marks)

(Answer all Questions)

Q. No.	Questions	Marks	CO	BL
1	Draw the Bipolar (AMI) NRZ encoded waveform of the following bit sequence: 10000101011100001010 Also, draw the B3ZS encoded wave form.	2	3	2
2	Encode the following sequence using Duobinary encoder: 10010101011. What is the problem associated with Duobinary encoding? How do you circumvent the same?	2	3	2
3	Give any two properties of Cyclic Codes.	2	2	1
4	Specify the advantage and disadvantage of Channel coding schemes.	2	2	1
5	Give Shannon –Hartley Law. What do you understand by that?	2	1	1
6	Define 'Entropy' of a Discrete Memoryless Source (DMS). Calculate the entropy of a DMS emitting 32 equiprobable symbols.	2	1	2
7	Draw the block diagram of a Non-Coherent FSK receiver	2	4	2
8	What is the equivalence between Matched Filter and Correlator?	2	4	2
9	.What is bit / symbol synchronization?	2	5	2
10	What is Frame Synchronization?	2	5	2

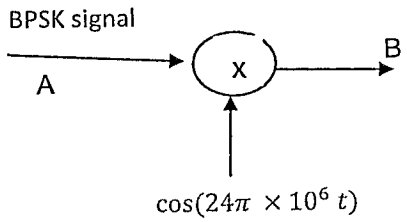
PART- B (5x 13=65Marks)

Q. No.	Questions	Marks	CO	BL
11 (a)	(i) Derive the Power Spectral density of Unipolar NRZ coding scheme. Draw the power spectral density and mention the special features of the Unipolar NRZ.	9	3	4
	(ii) Encode the following bit sequence using Unipolar NRZ and Polar RZ. 101011100011 Specify the important features by which Polar RZ and Unipolar NRZ differ (No derivation required for Polar RZ).	4	3	3
	OR			
11 (b)	(i) Define Inter Symbol Interference (ISI). Derive the (Nyquist) condition for the absence of ISI. Draw the frequency response and impulse response of the channel with minimum bandwidth satisfying Nyquist Criteria.	9	3	4
	(ii) What do you understand by Discrete Cosine Pulses?	4	3	3
12 (a)	Consider a (7,4) code whose generator matrix is $G = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$ (i) Find all the codewords of the code. Find the error-detecting and error- correcting capability of the code.	8	2	4
	(ii) Find H, the Parity Check matrix. Compute the Syndrome for the received vector **1101101**. Is this a valid code vecotor?	5	2	4
	OR			

12 (b)	Consider the convolutional encoder of code rate ½ given below. (i) Draw the state diagram and trellis diagram of the encoder. Assume that the registers initially contain zeroes. If the input data sequence is 10010110, find the output code sequence.  	**8**	2	4
	(ii) If the received code sequence (convolutionally encoded) is **000100000010**, obtain the corrected data sequence.	**5**	2	4
13 (a)	(i) Encode the symbol set $\{s_1,s_2,s_3,s_4,s_5\}$ with associated set of probabilities { 0.04, 0.06, 0.4, 0.2, 0.3 } using Huffman coding. Compute the average code word length and efficiency of the code.	**9**	1	3
	(ii) Find the Mutual Information and Channel capacity of the channel represented by the following channel diagram (a_i and b_i represent the transmitted and received symbol respectively)  	**4**	1	3
	OR			
13 (b)	(i) A sequence is made up of three alphabets G,M and P. Assume an LZW code starts with the initial dictionary G → 1 M → 2, P → 3. Encode the following sequence using LZW coding: **GMMGMPGMGPGMPGMGMMGGMPGM** What is the compression ratio?	**9**	1	3
	(ii) Give an overview of the LPC based speech encoder .	**4**	1	3

14 (a)	(i) Derive the relation between the BERs of BPSK and QPSK. State the relation between the bandwidths of BPSK and QPSK with suitable justification (No derivation required).	9	4	3
	(ii) Give the block diagram of DPSK encoder and decoder. With suitable arguments, bring out the advantage of DPSK over BPSK.	4	4	3
	OR			
14 (b)	Draw the signal Constellation of a BPSK signal and derive the expression for the Probability of Error.	13	4	3
15 (a)	(i) Give the block diagram of a Frequency Hop spread spectrum transmitter and receiver and explain. Assuming the data modulation is 4- FSK and the data sequence is 100111001101001011 . Demonstrate Fast Frequency Hop Spread Spectrum and slow Frequency Hop Spread Spectrum assuming a suitable spreading code.	10	6	3
	(ii) Give the applications of spread spectrum	3	6	3
	OR			
15 (b)	Draw the block diagram of a Direct Sequence spread Spectrum Transmitter and Receiver and explain. Derive the expression for the Processing Gain of the Direct Sequence Spread Spectrum system.	13	6	3

PART- C (1x 15=15Marks)
(Q.No.16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16.	(i) Consider a BPSK modulated wave, modulated by a data sequence at a bit rate of 4 kbps with a carrier of frequency 13 MHz and amplitude 3 mV. Draw the Power spectral density of the BPSK signal. What is the power in the BPSK signal?  Consider the signal available at B and suggest a suitable scheme to extract the data sequence from the signal at B. Draw the spectrum at each intermediate point. Give the block diagram of the carrier synchronization scheme used and the specifications of the modules within the same.	12	4	5
	(ii) Suppose the data is cyclically encoded by a (7,4) cyclic encoder and the encoded sequence BPSK modulates the carrier as specified in (i). Draw the spectrum at stage A. What is the power in the BPSK signal?	3	2	5