BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN											Course Code	2	1	E	C	5	1

Fifth Semester B.E. Degree Examinations, April/May 2024

COMMUNICATION SYSTEMS - II

Duration: 3 hrs **Max. Marks: 100**

Note:* 1. *Answer any* FIVE *full questions choosing ONE full Question from each Module.
2. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO:PI)
		Module-1		
1.	**a.**	List the advantages of digital communication over analog communication.	**05**	(2 :1: 1.3.1)
	b.	Explain the DPSK generator with a neat block diagram and also draw the related waveforms.	**07**	(2 :1: 1.3.1)
	c.	Binary data is transmitted using PSK at a rate of 2 Mbps over an RF link having a bandwidth of 2 MHz. Find the signal power required at the receiver input so that the error probability is less than or equal to 10^{-4}. Assume noise PSD to be 10^{-10} Watt/Hz.	**08**	(3 :1: 1.3.1)
		(OR)		
2.	**a.**	Draw BFSK, BPSK, and DPSK (take ref bit=1) waveforms for the data 11010010.	**06**	(2 :1: 1.4.1)
	b.	Briefly explain the digital communication system with a neat block diagram.	**06**	(2 :1: 1.3.1)
	c.	Explain the QPSK modulation system with a neat block diagram and suitable equations.	**08**	(3 :1: 1.3.1)
		Module-2		
3.	**a.**	Briefly explain the Gram -Schmidt orthogonalization procedure with necessary basis functions.	**06**	(2 :2: 1.3.1)
	b.	Explain the operation of matched filter receiver.	**06**	(2 :2: 1.3.1)
	c.	What is a PN sequence? Explain the generation of direct sequence spread spectrum signal with the relevant waveforms.	**08**	(2 :2: 1.3.1)
		(OR)		
4.	**a.**	Write a short note on the generation of maximum length (ML) sequence and mention its properties.	**06**	(2 :2: 1.3.1)
	b.	Tabulate the difference between the slow and fast frequency hopping spread spectrum.	**06**	(2 :2: 1.3.1)
	c.	Explain the model of the spread spectrum digital communication system with a neat diagram.	**08**	(2 :2: 1.3.1)

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)

Module-3

5.	**a.**	Derive the expression for the entropy of zero memory source emitting long independent symbols.	**06**	(2 :3: 1.3.1)
	b.	Consider a source with alphabets X1 and X2 with respective probabilities 0.7 and 0.3. Determine the entropy of the source H(S) and show that for the second extension of the source $H(S^2) = 2\,H(S)$ by listing the symbols of the second extended source along with their probabilities.	**06**	(3 :3: 1.4.1)
	c.	The international Morse code uses a sequence of dots and dashes to transmit letters of the English alphabet. The dash is represented by a current pulse that has a duration of 3 units and the dot has a duration of 1 unit. The probability of occurrence of a dash is half of the probability of occurrence of a dot. (i) Calculate the self-information content of a dot and a dash. (ii) Calculate the average information in the dot-dash code.	**08**	(3 :3: 2.1.3)

(OR)

6.	**a.**	What is source coding? And briefly summarize the source coding theorem.	**06**	(2 :3: 1.3.1)
	b.	Apply Shannon's binary encoding algorithm to construct a binary code for the given discrete source with three symbols S = {S1, S2, S3} and the respective probabilities are P = {0.4, 0.3, 0.3}.	**06**	(3 :3: 1.4.1)
	c.	Construct Huffman Ternary code for the following source symbols $S = \{s_1, s_2, s_3, s_4, s_5, s_6\}$ with P = {1/3, 1/4, 1/8, 1/8, 1/12, 1/12}. Determine code efficiency and redundancy of the code.	**08**	(3 :3: 1.4.1)

Module-4

7.	**a.**	The generator matrix of a (7,3) LBC is given by $[G]=\begin{bmatrix}1&0&0&1&1&1&0\\0&1&0&0&1&1&1\\0&0&1&1&1&0&1\end{bmatrix}$ (i) Find all the possible valid code words (ii) Write the parity check matrix (iii) Draw the encoder circuit (iv) What is the error detection and correction capability of the code? (v) Is Received code [R] = [0101010] a valid code? If not find the syndrome.	**10**	(3 :4: 1.4.1)
	b.	The parity check bits of a (8,4) LBC are given by $C_5=d_1+d_2+d_4$ $C_6=d_1+d_2+d_3$ $C_7= d_1+d_3+d_4$ $C_8=d_2+d_3+d_4$ Where d_1, d_2, d_3, d_4 are data bits. (i) Find [G] and [H] matrices. (ii) Find all the 2^k possible code vectors. (iii) How many errors it can detect and correct? (iv) Draw the syndrome calculation circuit.	**10**	(3 :4: 1.4.1)

(OR)

8.	**a.**	Discuss the need for error control coding.	**04**	(2 :4: 1.3.1)

	b.	Define (i) Linear block code (ii) Hamming weight (iii) Minimum hamming distance with an example.	**06**	(2 :4: 1.3.1)
	c.	For a systematic (6,3) LBC, the parity matrix is $[p]=\begin{bmatrix}1 & 0 & 1\\ 0 & 1 & 1\\ 1 & 1 & 0\end{bmatrix}$ (i) Construct [G] and [H] matrices. (ii) Draw the decoder diagram. (iii) Is Received code [R] = [110101] a valid code? If not find the syndrome. (iv) If there is an error, detect the error and correct the error.	**10**	(3 :4: 1.4.1)

Module-5

9.	**a.**	Design the encoder for the (7,4) cyclic code generated by $g(x)=1+X+X^3$ and find the code word for the message vector [D] = 1101 by listing the contents of the shift register.	**06**	(3 :5: 1.4.1)
	b.	For a (7, 3) cyclic code has $g(x)=1+X+X^2+X^4$. Is $R(x)=1+X^3+X^4+X^5+X^6$ a valid received code polynomial? If not, find the syndrome using algebraic or polynomial arithmetic or by hand calculation.	**06**	(3 :5: 1.4.1)
	c.	For the (2, 1, 3) convolutional encoder with $g^{(1)}$ = [1101], $g^{(2)}$ = [1011]. Draw the convolutional encoder block diagram and find the output for the message 10110 using the time domain approach and verify the output using the [G] matrix.	**08**	(3 :5: 1.4.1)

(OR)

10	**a.**	The generator polynomial for a (15,7) cyclic code is given by $g(x)=1+X^4+X^6+X^7+X^8$. Find the code vector in systematic form for the message polynomial $D(x)=X^2+X^3+X^4$ using by-hand calculation.	**06**	(3 :5: 1.4.1)
	b.	Draw the decoder circuit for a (7,4) cyclic code generated by $g(x)=1+X+X^3$ and calculate the syndrome for the received sequence [R] = (1 0 0 1 1 0 1) by listing the contents of the shift register.	**06**	(3 :5: 1.4.1)
	c.	For the (2, 1, 2) convolutional encoder with $g^{(1)}$ = [101] and $g^{(2)}$ = [111], draw the tree diagram and state diagram.	**08**	(3 :5: 1.4.1)

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Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)