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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (R, S) / S6 (PT) (R) Examination June 2023 (2019 Scheme)

Course Code: ECT306

Course Name: INFORMATION THEORY AND CODING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1	Consider a source S = {S_1, S_2, S_3} with P = {1/2,1/4,1/4)}. Find self-information of each message and entropy of source S?	(3)
2	Define coding and explain the necessity of coding?	(3)
3	State the positive and negative statements of Shannon's channel coding theorem.	(3)
4	Explain BSC with its channel diagram.	(3)
5	Distinguish between block codes and convolutional codes.	(3)
6	Explain how generator matrix is obtained for a linear block code.	(3)
7	What is BCH code?	(3)
8	List any three properties of cyclic code.	(3)
9	For a (2,1,2) convolutional encoder with impulse response g(1)=[111] and g(2)=[101], find the output sequence for the message D =1 0 0 1 1 by time domain approach.	(3)
10	Explain trellis diagram.	(3)

PART B

Answer one full question from each module, each carries 14 marks.

Module I

11	a)	Show that H (X, Y) = H(X/Y) + H(Y).	(7)
	b)	Given the messages X_1, X_2, X_3, X_4, X_5 and X_6 with respective probabilities of 0.4, 0.2, 0.2, 0.1, 0.07 and 0.03. Construct a binary code by applying Huffman encoding procedure. Also determine its efficiency and redundancy.	(7)

OR

12	a)	Construct an instantaneous binary code for a source producing 5 symbols S_1 to S5 with respective probabilities of {1/2, 1/6,1/6,1/9,1/18}. Also find the code efficiency and redundancy?	(7)

b) The joint probability of a pair of random variable is given below. Determine H(X), H(Y), H(X,Y), H(X/Y), H(Y/X) and I(X,Y) .Verify the relation between joint, conditional and marginal entropies? (7)

$$P(X,Y)= \begin{bmatrix} 1/3 & 1/3 \\ 0 & 1/3 \end{bmatrix}$$

Module II

13 a) Explain Bandwidth-efficiency relation and Shannon's Limit of a continuous Gaussian channel. (7)

b) A message source produces two independent symbols A and B with probabilities P(A)=0.4 and P(B)=0.6 and transmitted through a BSC. Calculate the Information transmission rate of the system if the symbols are received in average with 4 in every 100 symbols in error. (7)

OR

14 a) Calculate the capacity of a Gaussian channel with a bandwidth of 1MHz and S/N ratio of 30dB. (7)

b) Explain Binary Erasure Channel and derive its channel capacity. (7)

Module III

15 a) Construct the encoding circuit of a systematic (6,3) LBC with the parity matrix given by (7)

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

Also find all possible code vectors.

b) Explain the error detection and correction capabilities of linear block code. (7)

OR

16 a) Explain the procedure to prepare the standard array of LBC. Also construct the standard array of (4,2) LBC whose parity matrix is given by, $P = \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$ (7)

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

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

A single error has occurred in the received vectors [0111110] and [1011100]. Detect and correct the error?

Also draw the syndrome calculation circuit?

Module IV

17 a) Draw the general encoding circuit for (n,k) cyclic code and explain its operation. (7)

b) Find the generator and parity check matrices of (7,4) cyclic code where (7)
$x^n+1= x^7+1 = (1+x+x^3)(1+x+x^2+x^4)$.

OR

18 For a (7,4) cyclic code, the received vector Z(x) is 1110101 and the generator polynomial is $g(x)=1+x+x^3$. Draw the syndrome calculation circuit and explain the procedure with the register contents. Also correct the single error in the received vector. (14)

Module V

19 Consider a (3,1,2) convolutional code with $g^{(1)}=(1\ 1\ 0)$, $g^{(2)}=(1\ 0\ 1)$ and $g^{(3)}=(1\ 1\ 1)$. (14)

i) Draw the encoder block diagram.

ii) Find the generator matrix.

iii) Find the code vector corresponding to the information sequence (1 1 1 0 1) using time domain and transfer domain approach.

OR

20 Explain Viterbi algorithm for decoding of convolutional code with example with the help of figure. (14)

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