Reg No.:_____ Name:_____

1200ECT306052303

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) / S6 (PT) (S) Examination January 2024 (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 A source is transmitting six different messages at the rate of 100 msg/sec. The probabilities of the messages are ½, ¼, 1/6, 1/8, 1/32 and 1/32. Calculate the information rate. (3)

2 Define Entropy and list its properties. (3)

3 State Shannon's second theorem on channel capacity. Give the Positive and Negative statements. (3)

4 Explain Binary Symmetric Channel. (3)

5 A (6, 3) linear block code has a generator matrix given by $\begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$. Find all the code vectors. (3)

6 Explain the error detection and error correction capability of a linear block code. (3)

7 The generator polynomial of a (7, 4) Cyclic code is $G(p) = p^3 + p + 1$. Find the code vectors in systematic form for the message vector 0101. (3)

8 Explain the BCH codes. (3)

9 Draw the encoder circuit of a (2, 1, 3) convolutional encoder, with sequences are [1 0 0 1] and [1 1 1 1] as impulse responses. (3)

10 Explain LDPC Codes. (3)

PART B

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

Module I

11 a) State and prove Kraft's inequality. (7)

b) A Discrete memoryless system has 6 codes with probabilities 1/3, 1/4, 1/8, 1/8, 1/12, and 1/12.Obtain the Huffman codes and find the code efficiency and redundancy. (7)

OR

12 a) The joint probability matrix of a communication system is given by (10)

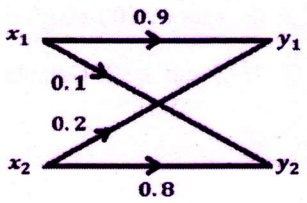
$P(XY) = \begin{bmatrix} 0.1 & 0.05 & 0.05 \\ 0.2 & 0.15 & 0.1 \\ 0.1 & 0.2 & 0.05 \end{bmatrix}$. Find H(X), H(Y), H(X,Y), H(X/Y) and H(Y/X).

b) Explain uniquely decodable and prefix free property of source code (4)

Module II

13 a) Derive the capacity of a Binary Erasure Channel. (6)

b) Given a binary channel, (8)



1. Find the channel matrix.
2. Find $P(y_1)$ and $P(y_2)$ given $P(x_1)= P(x_2)= 0.5$
3. Find the joint probability $P(x_1, y_2)$ and $P(x_2, y_1)$.

OR

14 a) A voice grade channel of a telephone network has a bandwidth of 3.4KHZ. (7)

a. Calculate the channel capacity of the telephone channel or a signal to noise ratio of 30dB.

b. Calculate the minimum signal to noise ratio required to support information transmission through the telephone channel at the rate of 4800bits/sec.

b) State Shannon Hartely theorem and explain the significance of Shannon Limit. (7)

Module III

15 a) The parity check list of an (8,4) linear block code is given by (12)

C5= d1+d2+d4

C6= d1+ d2+d3

C7=d1+ d3+d4

C8= d2+d3+d4

a. Find the generator and parity check matrix.

b. Find the minimum weight.

c. Calculate the error correction and detection capability.

d. Implement the encoder circuit.

b) List the properties to be satisfied by a linear block code? (2)

OR

16 a) Define ring and field. Discuss its properties. (5)

b) The parity matrix for a (7,4) linear block code is given by (9)

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

a. Find all code vectors.

b. Find Parity check matrix.

c. Implement an decoder circuit of the code

Module IV

17 a) The generator polynomial of a (7, 4) Cyclic code is $G(p) = p^3 + p + 1$. Find the code vectors corresponding to the message vectors 1011 and 1101 in Non-systematic form (10)

b) Discuss the properties of Hamming codes. (4)

OR

18 a) Draw syndrome circuit for a (7, 4) cyclic code generated by $g(x) = 1 + x + x^2$. If the received code word r is [0010110], what is the syndrome of r? Explain the circuit with a table showing the contents of syndrome register. (10)

b) Explain decoding of cyclic codes. (4)

Module V

19 For a Convolutional encoder, the generator sequences are given as, $g^{(1)} = (1,1,0)$ and $g^{(2)} = (1,0,1)$. Obtain the state diagram and encode the message sequence (1011). Also verify the output sequence using Transform domain approach. (14)

OR

20 For a (2,1,2) convolutional encoder with generator sequences $g^{(1)} = (1,1,1)$ and $g^{(2)} = (1,0,1)$. Draw the Trellis diagram and perform Viterbi decoding on this trellis for the received sequence {01, 10, 10, 11, 01, 01, 11} and obtain the estimate of the transmitted sequence. (14)

****