A

10000EC401122101

Pages: 2

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Regular and Supplementary Examination December 2021 (2015 Scheme)

Course Code: EC401

Course Name: INFORMATION THEORY & CODING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

Marks

1 a) Define the term marginal entropy and give its units? What will be the marginal entropy if a source emits all the M messages with equal probability? (5)

b) Let X and Y be two discrete random variables and their joint probability is given by (10)

$$P(X,Y) = \begin{bmatrix} .08 & .15 & .11 \\ .06 & .09 & .14 \\ .02 & .03 & .06 \\ .13 & .09 & .04 \end{bmatrix}$$

Find marginal, conditional and joint entropies and verify the relation.

2 a) State and prove Kraft's inequality (7)

b) Two symbols x_1, x_2 with probabilities $P(x_1) = 0.4$ and $P(x_2) = 0.6$ are transmitted through a discrete channel given below. (8)

$$P(Y/X) = \begin{bmatrix} 0.8 & 0.2 \\ 0.2 & 0.8 \end{bmatrix}.$$

Identify the channel and calculate the capacity and the efficiency of the channel.

3 a) Define mutual information I(X; Y). Find the mutual information if X and Y are independent. (5)

b) A discrete source emits 7 symbols with probabilities, 0.15, 0.24, 0.13, 0.26, 0.12, 0.02, 0.08. Construct binary codes using Huffman algorithm and Shannon Fano algorithm. Compare the efficiencies of these two codes. (10)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Find the differential entropy of a Gaussian distributed random variable. (7)

b) Derive the capacity of a Gaussian channel with bandwidth B and noise power spectral density N/2. Also, find the capacity when the bandwidth of the channel tends to infinity. (8)

5 a) Define Ring and give two examples (5)

b) Parity matrix of a (7,4) systematic linear block code (LBC) is given as (10)

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

1) Find the generator and parity check matrices.

2) Draw the syndrome calculation circuit.

3) Explain the decoding using the syndrome of a received vector.

6 a) Construct standard array of an Linear Block Code with generator matrix, (10)

$$G = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}.$$

Find the transmitted codeword corresponding to the received vector, '111110'.

b) A continuous channel has a bandwidth of 4.8 KHz. For a signal to noise ratio of 20dB, calculate the channel capacity. Also, calculate the minimum SNR in dB required to support information transmission at the rate of 4800 bits/sec through the channel. (5)

PART C

Answer any two full questions, each carries 20 marks.

7 a) For a (7,4) cyclic code in systematic form with generator polynomial $1+X+X^3$ (10)

1) Find the codewords in systematic form corresponding to the message vectors (1010) and (1100).

2) Find the generator matrix corresponding to the systematic cyclic code.

3) Draw the encoder circuit and explain encoding of the message (1010)

b) With the help of a block diagram, explain the decoding of cyclic codes. (10)

8 a) Discuss minimum free distance of a convolutional code. (5)

b) Draw the state diagram and trellis diagram of a (3,1,2) convolution encoder with $g^{(1)} = (1\ 0\ 1)$, $g^{(2)} = (1\ 1\ 0)$, $g^{(3)} = (1\ 1\ 1)$. (15)

9 a) Discuss the encoding and decoding of Hamming codes with a suitable example. (8)

b) Draw a (2, 1,3) convolutional encoder with [1, 0, 0, 1] and [1, 1, 0, 1] as the impulse responses. Find the output of the convolutional encoder for input sequence 11001. (7)

c) What are Reed Solomon codes? Discuss its properties. (5)

****