Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

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) A source emits one of four symbols S_0, S_1, S_2 and S_3 with probabilities 1/3, 1/6, 1/4, 1/4 respectively. The successive symbols emitted by the source are statistically independent. Calculate the entropy of the source. (3)

b) If X and Y are discrete random sources and P(X,Y) is their joint probability distribution and is given as (12)

P(X,Y)=0.08 0.05 0.02 0.05

0.15 0.07 0.01 0.12

0.10 0.06 0.05 0.04

0.01 0.12 0.01 0.06

Calculate H(X), H(Y), H(X/Y), H(Y/X), H(X, Y) and I(X,Y).
Verify the formula H(X, Y) = H(X)+H(Y/X).

2 a) State Shannon's channel coding theorem. Give its positive and negative statements. (5)

b) An information source produces sequences of independent symbols A,B,C,D,E,F,G with corresponding probabilities 1/3,1/27,1/3,1/9,1/9,1/27,1/27. Construct a binary code and determine its efficiency and redundancy using (10)

i) Shannon –Fano coding procedure

ii) Huffman coding procedure.

3 a) What is meant by a symmetric channel? How do we find the capacity? (5)

b) Discuss binary symmetric and binary erasure channel? Draw the channel diagrams and derive the expressions for their channel capacities. (10)

PART B

Answer any two full questions, each carries 15 marks.

4 a) The parity matrix of a (6,3) linearsystematic block code is given below. (7)

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

Construct standard array.

b) State and derive Shannon-Hartley theorem. Explain the implications. (8)

5 a) Derive the expression for channel capacity when bandwidth becomes infinite. (7)

b) A voice grade channel of the telephone network has a bandwidth of 3.4 KHz. (8)

(a) Calculate channel capacity of the telephone channel for signal to noise ratio of 30 dB.

(b) Calculate the minimum SNR required to support information transmission through the telephone channel at the rate of 4800 bits/sec.

6 a) Define ring and field. Discuss properties. (5)

b) The parity matrix for a (7,4) linear block code is given below: (10)

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

i) Find generator and parity check matrices

ii) Draw the encoder circuit.

iii) Sketch the syndrome calculation circuit

iv) Illustrate the decoding of the received vector corresponding to the message vector 1001, if it is received with 5th bit in error.

PART C

Answer any two full questions, each carries 20 marks.

7 a) Draw a (2, 1,3) convolutional encoder with [1, 0, 1, 1] and [1, 1, 1, 1] as the impulse responses. Find the output of the convolutional encoder for input sequence 11011 using transform domain approach (8)

b) Given $G(D) = [\ 1, 1 + D + D^{3}]$, design a (2, 1, 3) convolutional encoder of rate = ½. (7)

c) Discuss properties of Hamming codes. (5)

8 a) Construct a convolution encoder, given rate 1/3, constraint length L = 3. Given $g^{(1)} = (1\ 0\ 0)$, $g^{(2)} = (1\ 0\ 1)$, $g^{(3)} = (1\ 1\ 1)$. Sketch state diagram and trellis diagram of this encoder. (15)

b) Discuss syndrome decoding of cyclic code. Draw syndrome decoder circuit for a (15, 9) cyclic code with generator polynomial $g(X)= 1+ X^3+ X^4+ X^5+ X^6$ (5)

9 a) Draw a (2,1,2) convolutional encoder with the feedback polynomials as $g_1(X)=1+X+X^2$ and $g_2(X)= 1+X^2$. Draw the code tree and trace output for input sequence 10011. (8)

b) Discuss generation of Hamming codes. (7)

c) What is minimum free distance of a convolutional code? (5)

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