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10EC55

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data may be suitably assumed.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Define the terms symbol rate and self information with examples for each. **(04 Marks)**

b. Justify the statement "The information content of a message is a logarithmic function of its probability of emission." **(06 Marks)**

c. Consider the state diagram of Fig.Q1(c),
i) Compute the state probabilities
ii) Find entropy of each state
iii) Find the entropy of the source

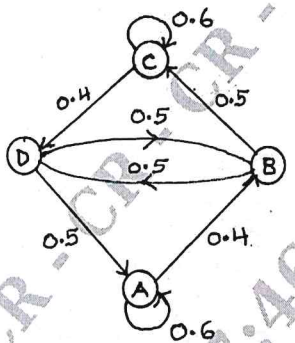

Fig.Q1(c) **(10 Marks)**

2 a. Explain the Shanon's encoding algorithm for generating binary codes. **(05 Marks)**

b. Apply Shannon's encoding algorithm to the following set of messages and obtain code efficiency and redundancy. **(05 Marks)**

m_1	m_2	m_3	m_4	m_5
$\frac{1}{8}$	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{8}$

c. With the aid of a suitable block diagram, explain discrete data communication channel, discrete communication channel and continuous channel. **(10 Marks)**

3 a. State and explain properties of mutual information. **(07 Marks)**

b. A transmitter transmits five symbols with probabilities 0.2, 0.3, 0.2, 0.1 and 0.2. Given the channel matrix P(B/A), calculate (i) H(B) (ii) H(A, B).

$$P\left(\frac{B}{A}\right) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ \frac{1}{4} & \frac{3}{4} & 0 & 0 \\ 0 & \frac{1}{3} & \frac{2}{3} & 0 \\ 0 & 0 & \frac{1}{3} & \frac{2}{3} \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

(08 Marks)

c. Explain how a communication channel is represented. What is a channel matrix? Explain. **(05 Marks)**

4 a. State and prove channel capacity theorem. State its implications. **(08 Marks)**

b. A voice grade channel of the telephone network has a bandwidth of 3.4 kHz.

i) Calculate channel capacity of a telephone channel for a signal-to-noise ratio of 30 dB.

ii) Calculate the minimum signal to noise ratio required to support information transmission through the telephone channel at the rate of 4800 bits/sec. **(08 Marks)**

c. An analog signal has a 4 kHz bandwidth. The signal is sampled at 2.5 times the Niquist rate and each sample is quantized into 256 equally likely levels. Assume that the successive samples are statistically independent. Find the information rate of this source. **(04 Marks)**

PART – B

5 a. Explain the matrix representation of linear block codes. **(06 Marks)**

b. Define and illustrate the following with an example.

i) Hamming weight

ii) Hamming distance **(04 Marks)**

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

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

i) Find all possible valid code vectors.

ii) Draw the corresponding encoding circuit.

iii) For a received code vector R = [0111110] detect and correct the error that has occurred.

iv) Draw a syndrome calculation circuit. **(10 Marks)**

6 a. A (15, 5) cyclic code has a generator polynomial $g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$.

i) Draw the block diagram of an error encoder.

ii) Draw the syndrome calculator for this code. **(10 Marks)**

b. For a (7, 4) cyclic code with received vector V = [1110101] with a generator polynomial $g(x) = 1 + x + x^3$, draw the syndrome configuration circuit and correct the error in received vector. **(10 Marks)**

7 Write short notes on:

a. RS codes

b. Golay codes

c. Shortened cyclic codes

d. Burst error correcting codes **(20 Marks)**

8 a. Bring out the differences between "Block code" and "convolution codes". Explain with a simple diagram the encoder for convolutional codes. **(06 Marks)**

b. Consider the (3, 1, 2) convolutional code with $g^{(1)} = (110)$, $g^{(2)} = (101)$ and $g^{(3)} = (111)$.

i) Find constraint length

ii) Find rate efficiency

iii) Draw the encoder block diagram

iv) Find the code word for the message sequence (11101) using time-domain and transfer approach. **(14 Marks)**

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