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10EC55

# Fifth Semester B.E. Degree Examination, June/July 2014
## Information Theory and Coding

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

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. A pair of dice are tossed simultaneously in an experiment outcome first dice is recorded as $x_1$ and 2nd dice as $x_2$. If the two events are:
$A\{x_1, x_2)$ such that $x_1 + x_2 \leq 8\}$ ; $B\{x_1, x_2)$ such that $x_1 > x_2\}$.
Then determine: i) Self information of A and B; ii) Entropy of the experiment. **(06 Marks)**

b. Consider the state diagram of a Markov source:

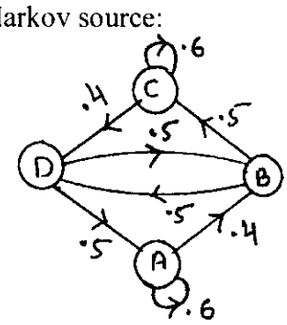


Fig.Q.1(b)

Determine: i) State probabilities; ii) Entropy of each state; iii) Entropy of source. **(08 Marks)**

c. Discuss: i) Additive property of entropy; ii) Symmetrical property of entropy. **(06 Marks)**

2 a. Find the minimum number of symbols, 'r' in the coding alphabet for devising an instantaneous code such that W = {0, 5, 5, 1, 5} device such a code. Where 'W' represent set of code word of length: 1, 2,....n. **(06 Marks)**

b. Construct a binary code for a source with five symbols $S = \{s_1, s_2, s_3, s_4, s_5\}$ with respective probabilities P = {·3, ·2, ·2, ·15, ·15}. Determine code efficiency using Shannon's coding. **(08 Marks)**

c. For the given channel matrix, calculate, H(x), H(y) and channel capacity given $P(x_1) = ·6$, $P(x_2) = ·3$ and $P(x_3) = ·1$

$$P(y/x) = \begin{bmatrix} 1/2 & 1/2 & 0 \\ 1/2 & 0 & 1/2 \\ 0 & 1/2 & 1/2 \end{bmatrix}.$$ **(06 Marks)**

3 a. Design a quarternary and binary source code for the source shown using Huffman's coding procedure S = {s1, s2, s3, s4, s5, s6, s7}; P = {·18, ·17, ·16, ·15, ·10, ·08, ·05} also determine code efficiency. **(10 Marks)**

b. Determine channel capacity of a binary erasure channel. **(10 Marks)**

4 a. Consider a random variable 'x' wholes PDF is shown in Fig.Q.4(a).

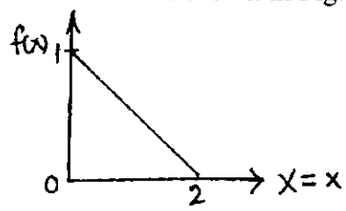


Fig.Q.4(a)

i) Determine the entropy of the source producing this variable.
ii) If the signal is passed through a linear amplifier of gain '8', determine entropy of o/p. **(08 Marks)**

b. Explain Shannon-Hartley law on channel capacity without proof. **(04 Marks)**

c. A CRT terminal is used to enter alphanumeric data in a system. CRT is connected through a telephone with B.W = 3kHz and $[S/N]_0$ = 10dB. Assuming the terminal has 100 characters and data is sent in an independent manner with equal probability:
i) Find average information per character.
ii) Capacity of channel.
iii) Data rate. **(08 Marks)**

## PART – B

5 a. Define the terms: i) Burst error; ii) Systematic linear block code; iii) Ealois field; iv) Hamming weight. **(04 Marks)**

b. For a systematic (6, 3) linear block code, the parity matrix is $[P] = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$. Find all possible code vectors and parity check matrix. **(06 Marks)**

c. Construct the standard array for example in Fig.Q.5(c). Hence determine corrected vector if received vector, z = '000011'. **(10 Marks)**

6 a. For a (7, 4) cyclic code the received vector Z(x) = 0100101 and the generator polynomial is $g(x) = 1 + x + x^3$. Draw the syndrome calculation circuit and correct the single error in the received vector also explain operation of circuit. **(10 Marks)**

b. For a (7, 3) expurgated Hamming code write the code vector table and draw the encoder circuit if $g(x) = 1 + x^2 + x^3$. **(10 Marks)**

7 Write short note on:
a. Burst-error correcting codes.
b. BCH code.
c. Golay code.
d. Shortened cyclic codes. **(20 Marks)**

8 For a (2, 1, 3) convolutional encoder with $g^{(1)} = [1101]$, $g^{(2)} = [1011]$.
a. Draw the convolutional encoder block diagram.
b. Write down the stat transition table.
c. Draw the code tree.
d. Find the encoder o/p produced by msg sequence "11101" by traversing through the code tree. **(20 Marks)**

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