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**Sixth Semester B.E. Degree Examination, December 2011
Information Theory and Coding**

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

- 1 a. The international morse code uses a sequence of dots and dashes to transmit letters of English alphabets. The dash is represented by a current pulse that has a duration of 3 units and the dot has a duration of 1 unit. The probability of occurrence of dash is 1/3 of the probability of occurrence of a dot.
 - i) Calculate the information content of a dot and a dash.
 - ii) Calculate the average information in the dot dash code.
 - iii) Assume that the dot lasts 1 msec which is the same interval as the pause between symbols. Find the average rate of information transmission. (08 Marks)
- b. For the source model shown in Fig.Q1(b), find the source entropy and the average information content per symbol in messages containing one, two and three symbols.

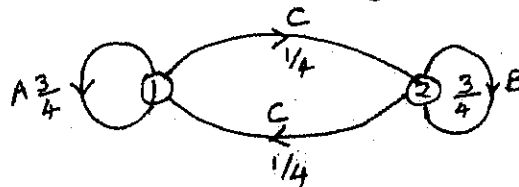


Fig.Q1(b)

(12 Marks)

- 2 a. For the binary symmetric channel shown in Fig.Q2(a), find the rate of information transmission over the channel when $p = 0.9, 0.8$ and 0.6 , given that the symbols rate is 1000/sec. (06 Marks)

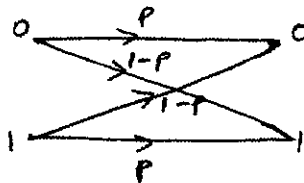


Fig.Q2(a)

$$P[x = 0] = 1/2$$

$$P[x = 1] = 1/2$$

- b. A source emits an independent sequence of symbols A, B, C, D and E with the probabilities 1/4, 1/8, 1/8, 3/16 and 5/16 respectively. Find the Shannon code and efficiency. (08 Marks)
 - c. A binary source emits an independent sequence of 0's and 1's, with probabilities p and $1 - p$. Prove that the entropy is maximum at $p = 1/2$. Plot the entropy. (06 Marks)
- 3 a. Explain the prefix coding and decision tree with examples. (08 Marks)
 - b. A discrete memoryless source has an alphabet of five symbols, with their probabilities as given below.

Symbol	S_0	S_1	S_2	S_3	S_4
Probability	0.55	0.15	0.15	0.10	0.05

Compute two different Huffman codes for this source. For each of the two codes, find

- i) The average code word length
- ii) The variance of the average code word length over the ensemble of source symbols. (12 Marks)

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.

- 4 a. Derive an equation for the capacity 'C' of a channel of Bandwidth B Hz effected by additive white Gaussian noise of power spectral density of $N_0/2$. (10 Marks)
- b. An analog signal has a 4 kHz bandwidth and is sampled at 2.5 times the Nyquist rate and each sample is quantized into one of 256 equally likely levels.
- What is the information rate of the source?
 - Can the output of this source be transmitted without errors over a Gaussian channel with a Bandwidth of 50 kHz and S/N of 20 db?
 - What will be the bandwidth requirements of an analog channel for transmitting the output of the source without errors, if the S/N ratio is 10 db? (10 Marks)

PART – B

- 5 a. Write a note on encoding and decoding of linear block code. (06 Marks)
- b. The parity clock bits of a (8, 4) block code are generated by
 $C_5 = d_1 + d_2 + d_4$ $C_6 = d_1 + d_2 + d_3$ $C_7 = d_1 + d_3 + d_4$ $C_8 = d_2 + d_3 + d_4$
 where d_1, d_2, d_3 and d_4 are message bits.
- Find the generator matrix and parity check matrix.
 - Find the minimum weight of this code.
 - Show through an example that this code can detect and correct errors. (08 Marks)
- c. Design a single error correcting code with a message block size of 8-bits. (06 Marks)
- 6 a. The generator polynomial of a (7, 4) cyclic code is $g(x) = 1 + x + x^3$.
- Find the codewords for messages 1010, 1110, 1100, 1111.
 - Find the codewords for i) using the systematic form. (08 Marks)
- b. Discuss the features of encoder and decoder, used for cyclic codes, with examples. (12 Marks)
- 7 Write short notes on any four:
- RS codes
 - BCH codes
 - Golay codes
 - Shortened cyclic codes
 - Burst error correcting codes. (20 Marks)
- 8 Consider a (3, 1, 2) convolutional code with
 $g^{(1)} = 110$; $g^{(2)} = 101$; $g^{(3)} = 111$
- Draw the encoder block diagram
 - Find the generator matrix
 - Find the codeword corresponding to the information sequence 11101, using the time domain and transform domain approach. (20 Marks)

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