

Second Semester M.Tech. Degree Examination, June/July 2015
Digital Signal Compression

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

- 1 a. For random variable x that takes on values from m -letter alphabet, show that $0 \leq H(x) \leq \log_2 M$. (08 Marks)
- b. Show that entropy is equal to the first order entropy where the elements of the observed sequence are iid. (08 Marks)
- c. Calculate the first order entropy of an alphabet $A = \{a_1, a_2, a_3, a_4\}$ that has probabilities $p(a_1) = 0.505$, $p(a_2) = 0.25$, $p(a_3) = 0.125$, $p(a_4) = 0.12$. (04 Marks)
- 2 a. Define conditional entropy, mutual entropy and average mutual information. For two random variables x and y show that
 - i) $H(x/y) \leq H(x)$
 - ii) $I(x; y) = I(y; x)$ (10 Marks)
- b. What is Rate distortion Theory? Derive the Rate distortion function for Gaussian Source. (10 Marks)
- 3 a. For an alphabet $A = \{a_1, a_2, a_3, a_4\}$ that has probabilities $p(a_1) = 0.1$, $p(a_2) = 0.3$, $p(a_3) = 0.25$ and $p(a_4) = 0.35$.
 - i) Design Huffman code in the normal method
 - ii) Design minimal variance Huffman code
 - iii) Comment on the difference in the codes. (12 Marks)
- b. For an alphabet $A = \{a_1, a_2, a_3\}$ with probabilities $p(a_1) = 0.7$, $p(a_2) = 0.1$, $p(a_3) = 0.1$ design 3 bit Tunstall code. (08 Marks)
- 4 a. Explain the uniform quantization for non uniform source. Derive the expression for mean square quantization error (MSQE) in the interval $[-4,4]$. (10 Marks)
- b. Explain backward adaptive quantization with suitable example. (10 Marks)
- 5 a. Explain the steps in LBG algorithm. (10 Marks)
- b. Explain basic differential encoding with a block diagram. (10 Marks)
- 6 a. Explain with diagram the principles of poly phase decomposition. (10 Marks)
- b. Explain with relevance to matrix properties the DWHT (Discrete Walsh – Hadmard Transform). (10 Marks)
- 7 Describe the LZW algorithm. Find the bit stream generated for the seven level decomposition shown. (20 Marks)

21	6	15	12
-6	3	6	3
3	-3	0	-3
3	0	0	0

- 8 a. Explain unique de codability of prefixcodes and Run length coding. (10 Marks)
- b. Explain coding in facsimile and MPEG audio coding. (10 Marks)