Digital Electronics

USN ☐☐☐☐☐☐☐☐☐☐   **12EC030**

M.Tech. Degree Examination, June/July 2013
Digital Signal Compression

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions.*

1 a. What is distortion? Obtain an equation for mean squared error and hence derive PSNR in terms of distortion and explain its importance. **(08 Marks)**

 b. Define prefix codes. State and prove the Kraft-Mcmillan inequality theorem for uniquely decodable codes. **(08 Marks)**

 c. Given an alphabet $A = \{a_1, a_2, a_3, a_4\}$. Find first order entropy in the following cases:

  i) $p(a_1) = 0.505$, $p(a_2) = \frac{1}{4}$, $p(a_3) = \frac{1}{8}$, $p(a_4) = 0.12$

  ii) $p(a_1) = p(a_2) = \frac{1}{8}$, $p(a_3) = \frac{1}{4}$, $p(a_4) = \frac{1}{2}$ **(04 Marks)**

2 a. Derive an expression for SNR in dB for uniform quantiser for an uniformly distributed source. **(08 Marks)**

 b. Briefly explain Karhunen-Loeve transform (KLT) and discrete cosine transform (DCT). Also state their advantages and disadvantages. **(06 Marks)**

 c. With an algorithm, explain the design of LBG-VQ approach. **(06 Marks)**

3 a. Design a Jayanth Quantiser and explain how the multiplier values are selected for an input sequence to be quantized:
   Input sequence : {0.1, −0.2, 0.2, 0.1, −0.3, 0.1, 0.2, 0.5, 1.5, 1.8}, Initial step size = 0.5, $M_0 = M_4 = 0.8$, $M_1 = M_5 = 0.9$, $M_2 = M_6 = 1.0$, $M_3 = M_7 = 1.2$ **(10 Marks)**

 b. Obtain the DCT, $F(u, v)$ for the given input sequence $f(i, j)$ = {2, 2, 2, 2 2, 2, 2, 2}. Show the step-wise calculations clearly. **(10 Marks)**

4 a. Define JPEG standard. List the main steps in JPEG image compression. **(10 Marks)**

 b. Summarize sub-band coding algorithm. **(10 Marks)**

5 a. Explain embedded zero tree wavelet (EZW) algorithm using 10-band decomposition. **(10 Marks)**

 b. Discuss code excited linear prediction (CELP). **(04 Marks)**

 c. Explain speech compression mechanism using linear predictive coding. **(06 Marks)**

6 a. With the help of a typical H.261 frame sequence. Explain H.261 image frame types. **(08 Marks)**

 b. Using pair wise nearest neighbour (PNN) algorithm and combining clusters, that causes small increase in distortion, generate a vector quantiser and calculate distortion. The height and weight values for vector quantiser are:
   (72, 180), (65, 120), (59, 119), (64, 150), (65, 162), (57, 88), (72, 175), (44, 41), (62, 114), (60, 110), (56, 91), (70, 172) **(05 Marks)**

 c. Explain MPEG audio-compression algorithm. **(07 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.

7 a. Using adaptive Huffman coding, draw a flow chart for the updating procedure. Encode the message (a, a, r, d, v) using update procedures. **(07 Marks)**

    b. If the initial codes for letters A, B and C are respectively 1, 2 and 3. Compress the string "ABABBABCABABBA". Using LZW, show the dictionary and obtain code. Calculate compression ratio. **(06 Marks)**

    c. What are arithmetic codes? Determine the tag for the sequence (a_1, a_3, a_2, a_1) using the probability model for an alphabet (a_1, a_2, a_3) with probability of occurrence $a_1 = 0.8$, $a_2 = 0.02$, $a_3 = 0.18$ **(07 Marks)**

8   Write short notes on:
    a. Companded quantization.
    b. Golomb codes and Tunstall codes.
    c. Adaptive delta modulation.
    d. Features of quantiser in G.726 speech coding standard. **(20 Marks)**

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