C 3266

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fourth Semester

Information Technology

IT 1251 — INFORMATION CODING TECHNIQUES

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Calculate entropy $H(X)$ for a discrete memoryless source X, which has four symbols x_1, x_2, x_3 and x_4 with probabilities $p(x_1) = 0.4$, $p(x_2) = 0.3$, $p(x_3) = 0.2$ and $p(x_4) = 0.1$.

2. Consider an additive white Gaussian noise channel with 4-kHz bandwidth and noise power spectral density $\frac{\eta}{2} = 10^{-2}$ w/Hz. The signal power required at the receiver is 0.1 mw. Calculate the capacity of this channel.

3. Write the condition required to avoid the slope over load distortion in delta modulation.

4. Define Hamming weight and Hamming distance.

5. State sampling theorem.

6. Show that $c = \{000, 001, 101\}$ is not a linear code.

7. What is the major advantage of the adaptive Huffman coding over static Huffman coding?

8. List the three tokens available at the output of the entropy encoder in JPEG algorithm.

9. Distinguish between global color table and local color table in GIF.

10. Mention two basic properties of linear prediction.

PART B — (5 × 16 = 80 marks)

11. (a) A discrete memoryless source X has five symbols x_1, x_2, x_3, x_4 and x_5 with probabilities $p(x_1) = 0.4$, $p(x_2) = 0.19$, $p(x_3) = 0.16$, $p(x_4) = 0.15$ and $p(x_5) = 0.1$.

(i) Construct a Shannon-Fano code for X, and calculate the efficiency of the code. (7)

(ii) Repeat for the Huffman code and compare the results. (9)

Or

(b) Consider that two sources S_1 and S_2 emit messages x_1, x_2, x_3 and y_1, y_2, y_3 with joint probability $p(X,Y)$ as shown in the matrix form.

$$p(X,Y) \rightarrow \begin{bmatrix} 3/40 & 1/40 & 1/40 \\ 1/20 & 3/20 & 1/20 \\ 1/8 & 1/8 & 3/8 \end{bmatrix}$$

Calculate the entropies $H(X), H(Y), H(X/Y)$ and $H(Y/X)$.

12. (a) With neat sketch and supportive mathematical expressions, briefly explain the working principle of differential pulse code modulation. (16)

Or

(b) Briefly describe about the two schemes available for coding the speech signals at low bit–rates, namely, adaptive differential pulse code modulation and adaptive subband coding. (16)

13. (a) For a (6, 3) systematic linear block code, the three parity-check bits c_4, c_5 and c_6 are formed from the following equations:

$c_4 = d_1 \oplus d_3$

$c_5 = d_1 \oplus d_2 \oplus d_3$

$c_6 = d_1 \oplus d_2$.

(i) Write down the generator matrix (5)

(ii) Construct all possible code words (5)

(iii) Suppose that the received word is 01011. Decode this received word by finding the location of the error and the transmitted data bits. (6)

Or

(b) (i) Let $g(x)$ be the generator polynomial of a cyclic code C. Find a scheme for encoding the data sequence $\{d_0, d_1, ..., d_{k-1}\}$ into an (n, k) systematic code C. (8)

(ii) Consider a (7, 4) cyclic code with generator polynomial $g(x) = 1 + x + x^3$. Let data d = (1010). Find the corresponding systematic code word. (8)

14. (a) Briefly describe the procedures followed in two of the text compression algorithms given below

(i) Dynamic Huffman coding (8)

(ii) Arithmetic coding (8)

Or

(b) With suitable block diagram, briefly explain JPEG encoder and JPEG decoder. (16)

15. (a) In connection with perceptual coding, briefly describe the following concepts

(i) Frequency masking (8)

(ii) Temporal masking (8)

Or

(b) With suitable block diagram, briefly explain the implementation schematic of H.261. Also, briefly explain macro-block and frame/picture encoding formats of H.261. (16)

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