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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Fifth Semester

Information Technology

IF 356 — INFORMATION CODING TECHNIQUES

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is known as the Shannon-Hartley law?

2. State source coding theorem.

3. A delta modulation system is designed to operate at 3 times the nyquist rate for a signal with a 3 KHz bandwidth. The quantizing step size is 250 mv. Determine the max amplitude of a 1 KHz input sinusoid for which the delta modulation does not show slope overload.

4. An analog signal is sampled at the Nyquist rate f_s and quantized into L levels. Find the time duration of 1 bit of the binary encoded signal.

5. Show that if c_i and c_j are two code vectors in an (n, k) Linear block code, then their sum is also a code vector.

6. Consider the following code vectors :

   c1 = [1 0 0 1 0]

   c2 = [0 1 1 0 1]

   c3 = [1 1 0 0 1]

   Show that d (c1, c2) + d (c2 + c3) ≥ d (c1, c3)

7. A source emits letters from an alphabet A = {a1, a2, a3, a4, a5} with probabilities p (a1) = 0.15, p (a2) = 0.04, p (a3) = 0.26, p (a4) = 0.05 and p (a5) = 0.50. Calculate the entropy of this source.

8. What is mean by adaptive differential pulse code modulation?

9. Compare JPEG and JPEG 2000 standards.

10. What is known as block-based motion compensation?

11. (a) (i) Describe Lossless channel, deterministic channel, noiseless channel and binary symmetric channel with suitable examples. (8)

    (ii) A discrete memory less source x has four symbols x1, x2, x3, x4 with probabilities P (x1) = 0.4, P(x2) = 0.3, P(x3) = 0.2, P (x4) = 0.1. Calculate H (x) and find the amount of information in the messages x1, x2, x1, x3 and x4, x3, x3, x2. (8)

Or

(b) (i) A discrete memory less source has four symbols x1, x2, x3 and x4 with $p(x1) = \frac{1}{2}$, $p(x2) = \frac{1}{4}$ and $p(x3) = p(x4) = 1/8$. Construct a Shannon-Faro code for x; show that this code has 100% code efficiency. (8)

    (ii) Two BSCs (Binary Symmetric Channels) are connected in cascade as shown in fig (1).
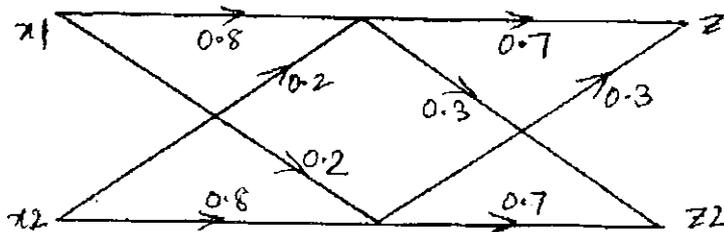
Fig (1) Qn. 11 (b) (ii)

Find the channel matrix of the resultant channel. Find $P(z1)$ if $P(x1) = 0.6$ and $P(x2) = 0.4$. (8)

12. (a) (i) Explain delta modulation in detail with suitable diagram. (10)

    (ii) What is slope overload distortion and granular noise in delta modulation and how it is removed in ADM? (6)

Or

(b) (i) A binary channel with bit rate R_b =36000 b/s is available for PCM voice transmission. Find appropriate values of the sampling rate f_s the quantizing level L and the binary digits n, assuming f_m = 3.2 KHZ. (8)

    (ii) Compare PCM, DPCM, DM and ADM. (8)

13. (a) (i) Using the generator polynominal $g(x) = 1 + x + x^3$, generate a systematic code word from the (7, 4) code word set for the message vector m = 1011. (4)

(ii) Construct an (n-k) stage cyclic encoder for an (n-k) binary cyclic code generated by $g(x) = 1 + g_1 x + g_2 x^2 + \ldots\ldots + g_{n-k-1} x^{n-k-1} + x^{n-k}$. Briefly explain about the encoding operation and verify its operation using information given in part (i). (12)

Or

(b) Consider the convolutional encoder shown in fig. (2)
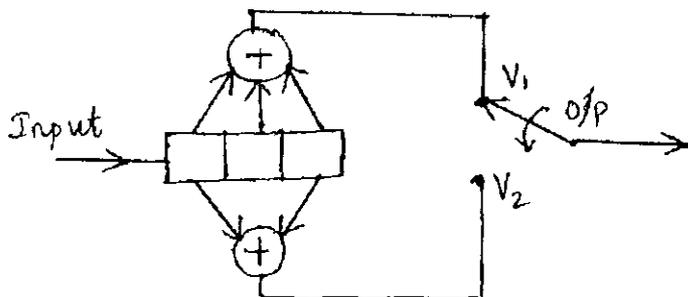
Fig. (2) Qn. 13 (b)

(i) Find the output code word if the input sequence is all 1's (11111 ....). (8)

(ii) Consider that the given encoder is used over a Binary Symmetric Channel (BSC). Assume that the initial encoder state is the 00 state. At the output of the BSC, the received sequence is r = (1100000111 rest all 0). Find the maximum likelihood path through the trellis diagram and determine the first 5 decoded data bits. (8)

14. (a) Compare and constrast the following :

(i) File formats

(1) TIFF   (2) GIF

(3) PNG and   (4) JPG   (8)

(ii) List out the significance of Discrete Cosine Transform (DCT) and why it is preferred to JPEG. Calculate DCT for the input image [1 2; 3 4]. (8)

Or

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(b) (i) For the probability model in Table 1

Letter	Probability
a1	0.2
a2	0.3
a3	0.5

Decode a sequence of length 10 with the tag 0.63215699. (8)

(ii) Consider a source A that generates letters form an alphabet of size four, A = {a1, a2, a3, a4} with probabilities $p(a1) = \frac{1}{2}$, $p(a2) = \frac{1}{4}$ $p(a3) = 1/8$, $p(a4) = 1/8$. Generate a binary code for this source. (8)

15. (a) (i) Explain the basic idea of DCT – based ITU-T H.261 video coding standard with suitable encoder block diagram. (8)

(ii) Mention the significant differences in the details of MPEG-1 and H.261 compression scheme. (8)

Or

(b) (i) Explain the main components of CELP coder with suitable encoder and decoder block diagram. (8)

(ii) How are the predictive coded (P) frames and bidirectionally predictive coded (B) frames are used to improve compression efficiency in MPEG-1 algorithm. (8)

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