



Printed Pages : 4

EC – 602

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3039

Roll No.

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B. Tech.

(SEM. VI) EXAMINATION, 2006-07

DIGITAL COMMUNICATION

Time : 3 Hours]

[Total Marks : 100

Note : Attempt all questions.

1 Attempt any **four** parts of the following : **5×4=20**

- (a) Consider a DMS with alphabet A, $A = \{-5, -3, -1, 0, 1, 3, 5\}$ with probabilities $\{0.05, 0.1, 0.1, 0.15, 0.05, 0.25, 0.3\}$. Source output is quantized according to following quantization rule :

$$q(-5) = q(-3) = 4$$

$$q(-1) = q(0) = q(1) = 0$$

$$q(3) = q(5) = 4$$

Find the entropy of the quantizer output.

- (b) Determine the differential entropy $H(X)$ of a uniformly distributed random variable X with PDF

$$f_x(x) = \begin{cases} \frac{1}{a} & . 0 \leq x \leq a \\ 0 & . otherwise \end{cases}$$

- (c) Prove that for a DMS an optimum prefix code exists in which two least probable letters have highest and equal length code words.

- (d) Show that $I(X; Y) = H(X) + H(Y) - H(XY)$.
- (e) State and explain the Shannon's noisy channel coding theorem.
- (f) Twelve different message signals with bandwidth of 10 kHz each, are to be multiplexed and transmitted. Determine the minimum bandwidth required if multiplexing is TDM and modulation is PAM.

2 Attempt any **four** parts of the following : 5×4=20

- (a) A sinusoidal signal is input to a mid-rise type uniform quantizer. Draw the quantizer output for one cycle of input.
- (b) Prove that the quantization noise power of a uniform quantizer is $\Delta^2/12$ where Δ is the quantizer step size.
- (c) What is the μ -law of companding. Give the input - output relationship and draw it.
- (d) Consider a delta modulator with sinusoidal input signal of amplitude A_m and frequency f_m . Show that slope over load distortion will occur if

$$A_m > \frac{\Delta}{2 \pi f_m T_s}$$

where Δ is the modulator step size and T_s is the sampling period.

- (e) Explain with the help of block diagram the working of a DPCM system.
- (f) What is the signal format for M12 Mux for AT&T (Bell) system. Describe it briefly.

3 Attempt any **two** parts of the following : **10×2=20**

- (a) Give the expression of a raised cosine spectrum with roll-off factor $\alpha = \frac{3}{4}$. Draw the spectrum. Determine its Bandwidth and derive the pulse in time – domain.
- (b) Given a bit sequence of 1100010, draw line codes in unipolar and Manchester signaling formats. Give expressions for power spectral densities of these formats and compare their noise performance.
- (c) Derive and show that the maximum output SNR of a matched filter is dependent on the energy of the signal only and not on the shape.

4 Attempt any **two** parts of the following : **10×2**

- (a) Derive the expression for probability of bit error for coherent binary FSK scheme in AWGN channel.
- (b) Explain Gram-Schmidt procedure for orthogonal signals.
- (c) Show that the minimum frequency separation for orthogonality of binary FSK signals with coherent detection is $\Delta f = 1/2T$ where T is the duration of FSK signals.

5 Attempt any **two** parts of the following : **10×2**

- (a) Design a (5, 3) type systematic block coder with single bit error correction capability. Obtain its generator and parity check matrices.

- (b) (i) What are the conditions on n and k for (n, k) type cyclic code to exist? 4
- (ii) Consider a $(7, 4)$ type systematic cyclic code with generator polynomial $g(x) = 1 + x^2 + x^3$. Find code words corresponding to message sequences $[1011]$ and $[1111]$.
- (c) The block diagram of a binary convolutional coder is given below:

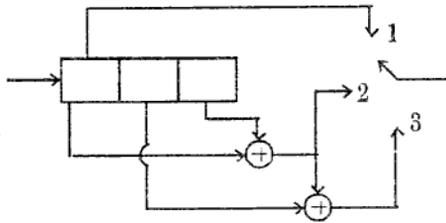


Fig. 1

Determine the minimum free distance d_{free} of the code.