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Printed Pages : 4 **EC – 602**

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

PAPER ID : 3039 Roll No.

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

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

(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 Am and frequency fm. 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 Ts 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:

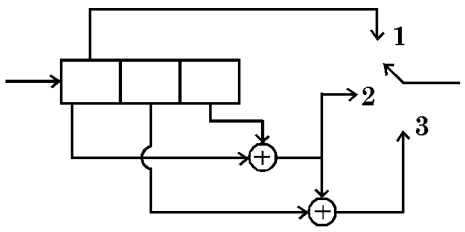

Fig. 1

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