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10EC/TE61

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Digital Communication

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain the quadrature sampling of band pass signal with related block diagram, spectra and equations. **(06 Marks)**

b. A low pass signal has the spectrum given by,

$$G(f) = \begin{cases} 1-|f|, & |f|<1 \\ 0, & |f|>1 \end{cases}$$

Assume that g(t) is sampled at 1.5 Hz and then applied to a low pass reconstruction filter with cut off frequency at 1 Hz. Plot the spectrum of the resulting signal. **(06 Marks)**

c. What is flat top sampling? Derive an expression for the flat top sampled signal. **(08 Marks)**

2 a. A PCM system uses a uniform quantizer followed by n-bit encoder. Show that rms signal to quantization noise ratio is approximately given by SNR = 1.8 + 6n dB. Assume that input to PCM system is a sinusoidal signal. **(06 Marks)**

b. The output signal to noise ratio of a 10 bit PCM was found to be 30 dB, the desired SNR is 42 dB. To increase the SNR to desired value by increasing the number of quantization levels. Find the fractional increase in transmission band width required for this increase in SNR. **(06 Marks)**

c. What is the necessity of non uniform quantization and explain companding? **(08 Marks)**

3 a. Explain differential pulse code modulation transmitter and receiver with relevant equations and show that the quantized version of the signal is sum of original sample value and quantization error. **(06 Marks)**

b. With reference to delta modulation system shown in Fig. Q3 (b) show that the optimum step size $K_{opt} = \frac{2\pi A}{(f_s/f_m)}$

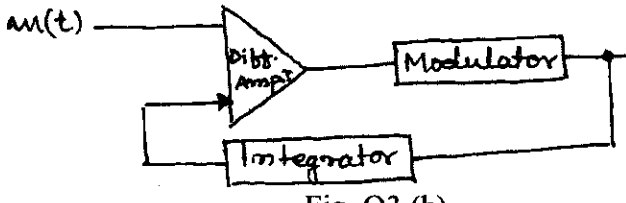

Fig. Q3 (b)

where A is amplitude of sine wave m(t), f_s is sampling frequency and f_m is the frequency of sine wave.

For K = 4 mV and K = 60 mV, does the slope overload occurs? If so in which case? Given $m(t) = 0.1\sin(2\pi \times 10^3 t)$ **(08 Marks)**

c. For a given binary sequence 0 1 0 1 1 1 0 0 1 0 1 1, draw the digital format waveform corresponding to ,

i) Split phase manchester coding waveform.
ii) Bipolar NRZ waveform and
iii) 8- ary signalling waveform. **(06 Marks)**

4 a. What is ISI? Derive an expression for Nyquist pulse shaping criterion for distortionless base band binary transmission. **(06 Marks)**

b. What is correlative coding? Explain duobinary coding with and without precoding. **(06 Marks)**

c. The binary data 0 1 1 1 0 0 1 0 1 are applied to the input of a modified duo binary system.
i) Construct the modified duo binary coder output without precoder.
ii) Suppose that due to error in transmission, the level produced by the third digit is reduced to zero. Construct a new receiver output. **(08 Marks)**

PART – B

5 a. With neat block diagram, explain the DPSK transmitter and receiver. **(10 Marks)**

b. For the binary sequence 0 1 1 0 1 0 0 0 explain the signal space diagram for coherent QPSK system. **(04 Marks)**

c. Derive an expression for probability of error for coherent binary PSK system. **(06 Marks)**

6 a. With block diagram, explain the principle of detection and estimation. **(06 Marks)**

b. Suppose $S_1(t)$, $S_2(t)$ and $S_3(t)$ are represented with reference to two basis functions $\phi_1(t)$ and $\phi_2(t)$. The co-ordinates of these signals are,

$S_1 = (S_{11}, S_{12}) = (3, 0)$

$S_2 = (S_{21}, S_{22}) = (-2, 3)$

$S_3 = (S_{31}, S_{32}) = (-3, -3)$

Draw the constellation diagram and express $S_1(t)$, $S_2(t)$ and $S_3(t)$ as linear combination of the basis functions. **(06 Marks)**

c. Consider the signal $S_1(t)$, $S_2(t)$, $S_3(t)$ and $S_4(t)$ as given below:

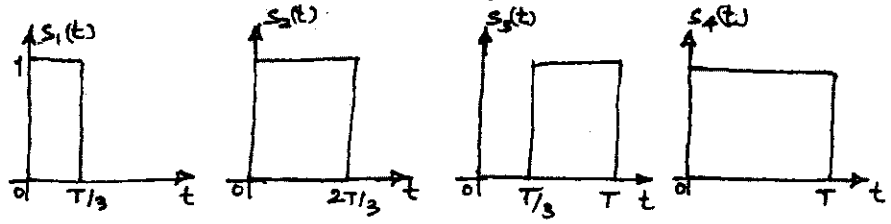

Fig. Q6 (c)

Find an orthonormal basis function for these set of signal using Gram-Schmidt orthogonalization procedure. **(08 Marks)**

7 a. Explain the function of correlation receiver. **(06 Marks)**

b. Show that the probability of bit error of a matched filter receiver is given by $Pe = \frac{1}{2}\text{erfc}\sqrt{\frac{E_b}{N_o}}$. **(08 Marks)**

c. A binary data is transmitted using ASK over a AWGN channel at a rate of 2.4 Mbps. The carrier amplitude at the receiver is 1mV. The noise power spectral density, $\frac{N_0}{2} = 10^{-15}$ watt/Hz. Find the average probability of error if the detection is coherent. Take $\text{erfc}(5) = 3 \times 10^{-6}$. **(06 Marks)**

8 a. Explain the working of direct sequence spread spectrum transmitter and receiver. **(08 Marks)**

b. Explain properties of PN sequence. **(06 Marks)**

c. Distinguish between slow frequency hopping and fast frequency hopping. **(06 Marks)**

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