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10EC/TE61

Sixth Semester B.E. Degree Examination, Feb./Mar. 2022
Digital Communications

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Show that Fourier transform of a uniformly sampled signal is a periodic spectrum in frequency domain with a period equal to sampling rate. Assume that signal is a finite energy, which is strictly band limited. **(07 Marks)**

b. A signal g(t) consists of two frequency components f_1= 3.9 K and f_2 = 4.1 K in such a way that they cancel each other when signal is sampled at t = 0, T, 2T….. where T = 125 μs. Signal is given by $g(t) = \cos(2\pi f_1 t + \pi/2) + A\cos(2\pi f_2 t + \phi)$. Find the values of A and ϕ of second component. **(06 Marks)**

c. Three message sources of bandwidths 1 kHz, 1 kHz and 2 kHz respectively are to be transmitted using TDM. Determine commutator arrangement, speed of commutator with each signal sampled at Nyquist rate and also the transmission bandwidth. **(07 Marks)**

2 a. What is aperture effect? How is it eliminated? **(04 Marks)**

b. If E denotes the energy of a strictly band limited signal g(t) then prove that $E = \frac{1}{2w}\sum_{n=-\infty}^{\infty}\left|g\left(\frac{n}{2w}\right)\right|^2$ where 'w' is the highest frequency of g(t). **(06 Marks)**

c. What is non uniform quantizer? Mention the features of non uniform quantizer. Explain A law and μ law compounding. Plot the input variance versus SNR of uniform and non uniform quantizer indicating the processing gain. **(10 Marks)**

3 a. Show that signal to quantization noise power ratio of uniform quantizer is $\frac{P}{\sigma_q^2} = \left(\frac{3P}{g_{max}^2}\right)2^{2n}$ where 'P' is signal power and g_{max} is overload amplitude of the signal. **(07 Marks)**

b. With the block diagram, explain adaptive delta modulation and receiver. **(07 Marks)**

c. A delta modulator is designed to operate at 3 times the Nyquist rate for a signal with 3 kHz bandwidth. Step size of quantizer is 250 mV. Determine maximum amplitude of 1 kHz input sinusoid for which delta modulator doesn't show slope overload error. Determine post filtered output SNR. **(06 Marks)**

4 a. With an example of binary data, explain how ISI can be utilized to increase signaling rate in duobinary signaling scheme. Explain with relevant equations and waveforms. **(09 Marks)**

b. State and prove Nyquist criterion for distortionless baseband binary transmission. **(06 Marks)**

c. Derive the power spectral density of polar type line code format. **(05 Marks)**

PART – B

5 a. Explain with neat block diagram, the coherent QPSK transmitter and receiver system with constellation diagram. **(08 Marks)**

b. Derive an expression for probability of error in coherent detection of binary PSK. **(08 Marks)**

c. Binary data is transmitted over a microwave link at the rate of 10^6 Mbps and PSD of noise at receiver is 10^{-10} W/Hz. Find the average carrier power required to maintain an average probability of error ≤ 10^{-4} for coherent detection of FSK.
Given data: u = 2 erf(2) = 0.9953, u = 2.5, erf(2.5) = 0.9995, u = 3, erf(3) = 0.99998. **(04 Marks)**

6 a. What is optimum receiver with respect to digital modulation scheme? Write the scheme for correlation receivers. **(06 Marks)**

b. Explain the encoding and decoding process of DPSK modulation scheme. What is its advantage over PSK? Implement it for a binary data 110100011. **(08 Marks)**

c. Prove and explain the properties of matched filter. **(06 Marks)**

7 a. Using Gram Schmidt orthogonalization procedure find a set of orthonormal basis functions to represent the signals $s_1(t)$, $s_2(t)$ and $s_3(t)$.

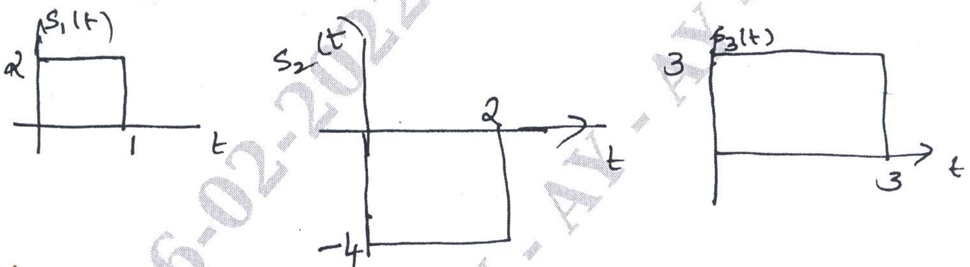

Fig.Q7(a) **(09 Marks)**

b. Determine the impulse response of matched filter and also plot the output of matched filter. Given s(t).

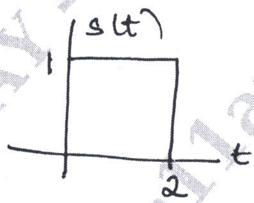

Fig.Q7(b) **(05 Marks)**

c. Show that energy of a signal is equal to square of length of corresponding vector s_i. **(06 Marks)**

8 a. With examples, explain the properties of PN sequence. **(06 Marks)**

b. What is direct sequence spread spectrum? Draw the block diagram and waveforms. **(06 Marks)**

c. What is frequency hop spread spectrum? Differentiate between slow hop and fast hop spread spectrum. **(08 Marks)**

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