Code No: NR310405 **NR** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
DIGITAL COMMUNICATIONS
Common to Electronics And Telematics, Electronics And Communication Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Why equalization is necessary is Base band transmission? Give the block diagram of adaptive filter and explain about each element. [8]
   (b) The unequalized pulse in a PAM system has the following values at sampling times:
   $$p_r\left(kT_b\right) = p_r\left(k\right) = \begin{cases} 0.2 & k = 1 \\ 0.8 & k = 0 \\ 0.2 & k = -1 \end{cases}$$
   $$p_{r(k)} = 0 \; for \; |k| > 1$$
      i. Design a three-tap zero forcing equalizer so that the equalizer output is 1 at k = 0 and 0 at k = ±1
      ii. Calculate P_{eq} (k) for k = ±2, ±3. [8]
2. Derive the expression for signal to noise ratio of Delta Modulation System. [16]
3. A signal band limited to 1MHz is sampled at a rate of 50% higher than Nyquist rate and quantized into 256 levels using a μ-law quantizer with μ=255.
   (a) Determine the signal to quantization noise ratio.
   (b) The SNR found in (a) was unsatisfactory.It must be increased at least by 10dB. Would you be able to obtain the desired SNR without increasing the transmission bandwidth, if it was found that a sampling rate 20% above the Nquist rate is adequate. If so, explain how. What is the maximum SNR that can be realized in this way. [16]
4. Briefly explain about the Code Tree, Trellis, and State Diagrams of a convolutional encoder with an example? [16]
5. (a) Define the band pass sampling theorem. Verify the signal recovery for the spectrum X(f) of an ideally sampled signal shown in Figure 1, for the two cases, when
      i. f_s = 20 KHz,
      ii. f_s = 30 KHz

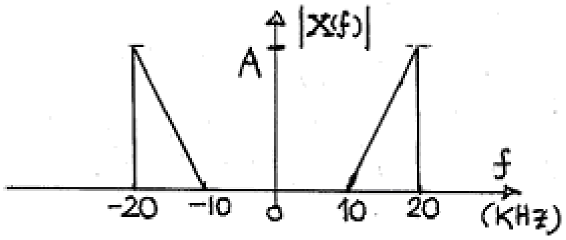

Figure 1

Sketch and explain the spectrum, bringing out the aliasing effects if any, in each case. [10]

(b) Two signals 10 Cos (1000 πt) and 10 Cos (50 πt) are both sampled at 75 Hz. Find and compare the sampled frequencies in both cases. [6]

6. A statistically independent sequence of equiprobable binary digits is transmitted over a channel having finite band width using the rectangular signaling wave form is taken. The bit rate is rb and the channel noise has a psd G_n(f) given by

   $G_n(f)=G_0[1+(f/f1)^2)]^{-1}$

   (a) find the transfer function of the optimum receiver and calculate the probability of error. [8]

   (b) If an integrate and dump receiver is used instead of the optimum receiver, find the probability of error for the optimum receiver. [8]

7. (a) Prove that impulse response of the modified duo-binary filter consists of two sine functions that are time-shifted by 2 T_p seconds, and sketch its response.

   (b) A source emits one of three equiprobable symbols in an independent sequence at a symbol rate of 1000 bps. Design a three level PAM system to transmit the output of this source over an ideal lowpass channel with additive Gaussian noise having a PSD of $\eta/2 = 10^{-14}$ Watt/Hz. The symbol error probability has to be maintained at or below 10^{-6}. Specify the power, bandwidth requirements and H_T (f), H_R (f) P_g(t). [8+8]

8. Four signals Cos ω_0t, 0.2 Cos ω_0t, 2 Cos 2 ω_0t and Cos 4 ω_0t are to be multiplexed in a TDM system. Find the minimum sampling rate f_s , minimum interval and the associated commutator speed. If the commutator rotates at $f_s/4$, and $f_s/8$ revolutions per sec., determine the number of o/p samples of each signal per rotation. Illustrate and explain this process with neat schematics for a commutator switch rotating at a speed of $f_s/4$ revolutions per sec., showing the transmitting and receiving sides. Discuss the necessity of synchronization for this case. [16]

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Code No: NR310405 **NR** **Set No. 4**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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2. A signal band limited to 1MHz is sampled at a rate of 50% higher than Nyquist rate and quantized into 256 levels using a μ-law quantizer with μ=255.
   (a) Determine the signal to quantization noise ratio.
   (b) The SNR found in
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   It must be increased at least by 10dB.Would you be able to obtain the desired SNR without increasing the transmission bandwidth, if it was found that a sampling rate 20% above the Nquist rate is adequate. If so, explain how. What is the maximum SNR that can be realized in this way. [16]

3. (a) Define the band pass sampling theorem. Verify the signal recovery for the spectrum X(f) of an ideally sampled signal shown in Figure8a, for the two cases, when
      i. f_s = 20 KHz,
      ii. f_s = 30 KHz

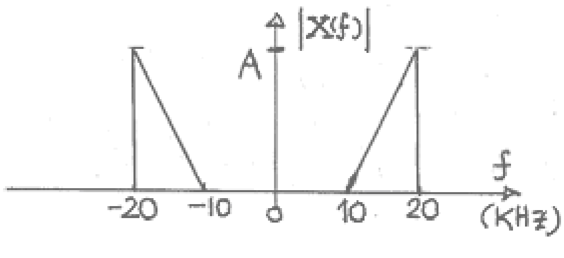

Figure 8a

   Sketch and explain the spectrum, bringing out the aliasing effects if any, in each case. [10]

(b) Two signals 10 Cos (1000 πt) and 10 Cos (50 πt) are both sampled at 75 Hz. Find and compare the sampled frequencies in both cases. [6]

4. (a) Why equalization is necessary is Base band transmission? Give the block diagram of adaptive filter and explain about each element. [8]

   (b) The unequalized pulse in a PAM system has the following values at sampling times:

$$p_r\left(kT_b\right) = p_r\left(k\right) = \begin{cases} 0.2 & k = 1 \\ 0.8 & k = 0 \\ 0.2 & k = -1 \end{cases}$$

$$p_{r(k)} = 0\, for\ |k| > 1$$

   i. Design a three-tap zero forcing equalizer so that the equalizer output is 1 at k = 0 and 0 at k = ± 1

   ii. Calculate P$_{eq}$ (k) for k = $\pm 2, \pm 3$. [8]

5. Four signals Cos ω_0t, 0.2 Cos ω_0t, 2 Cos 2 ω_0t and Cos 4 ω_0t are to be multiplexed in a TDM system. Find the minimum sampling rate f$_s$, minimum interval and the associated commutator speed. If the commutator rotates at f$_s$/4, and f$_s$/8 revolutions per sec., determine the number of o/p samples of each signal per rotation. Illustrate and explain this process with neat schematics for a commutator switch rotating at a speed of f$_s$/4 revolutions per sec., showing the transmitting and receiving sides. Discuss the necessity of synchronization for this case. [16]

6. A statistically independent sequence of equiprobable binary digits is transmitted over a channel having finite band width using the rectangular signaling wave form is taken. The bit rate is rb and the channel noise has a psd G$_n$(f) given by

   G$_n$(f)=G$_0$[1+(f/f1)^2)]$^{-1}$

   (a) find the transfer function of the optimum receiver and calculate the probability of error. [8]

   (b) If an integrate and dump receiver is used instead of the optimum receiver, find the probability of error for the optimum receiver. [8]

7. Derive the expression for signal to noise ratio of Delta Modulation System. [16]

8. Briefly explain about the Code Tree, Trellis, and State Diagrams of a convolutional encoder with an example? [16]

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Code No: NR310405 **NR** **Set No. 1**

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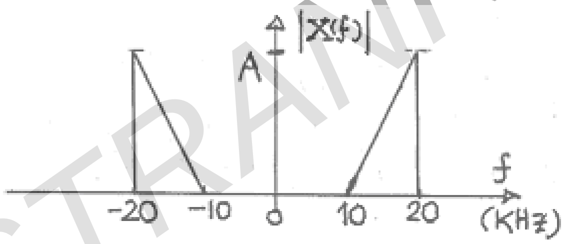

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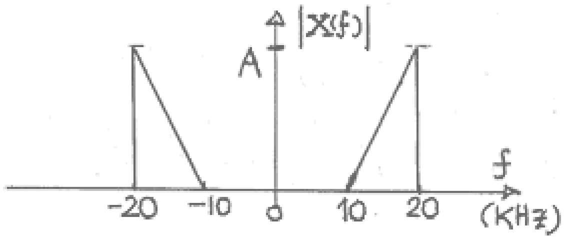

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