Code No: RR310405 **Set No.1**

III B.Tech. I Semester Supplementary Examinations, May -2005
DIGITAL COMMUNICATIONS
(Common to Electronics & Communication Engineering and Electronics & Telematics)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Define the Sampling theorem and establish the same for band pass signals, using neat schematics.
   (b) For the modulating signal m(t) = 2 Cos (100 t) + 18 Cos (2000 πt), determine the allowable sampling rates and sampling intervals.

2. 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.

3. (a) What is meant by Base Band data transmission?
   (b) Give the block diagram of Base Band binary data transmission system and explain the role of each block.
   (c) Sketch x(t) for binary PAM with data sequence 1011100010 when the signal has a unipolar format and pulse shape $P(t) = \cos^2\left(\frac{\pi t}{2T_b}\right)\ \pi\left(\frac{t}{T_b}\right)$

4. (a) What is meant by Synchronization in the base band PAM. What are the different methods to obtain Synchronization?
   (b) The T1 carrier system used in digital telephony multiplexes 24 voice channels based on 8-bit PCM. Each voice signal is usually put through a lowpass filter with cutoff frequency of about 3.4 KHz. The filtered voice signal is sampled at 8KHz. In addition, a single bit is added at the end of the frame for the purpose of synchronization. Calculate
      i. the duration of each bit
      ii. the resultant transmission rate and
      iii. the minimum required transmission bandwidth.

5. (a) Draw the block diagram of PCM Generator and explain each block.
   (b) Determine the Transmission Bandwidth in PCM.

6. (a) The ramp signal m(t) = at is applied to a DM which operates with a sampling period Ts and step size δ.

i. Show that the slope over load distortion occurs in δ <a T_s.

ii. Sketch the modulator output for the following three values of step size:

A. δ=0.75a T_s

B. δ=a T_s

C. δ=1.25a T_s

(b) Consider a speech signal with maximum frequency of 3.4 kHz and maximum amplitude of 1v. This speech signal is applied to a DM whose bit rate is set at 20kbps. Discuss the choice of appropriate step size for the modulator.

7. A statistically independent sequence of equiprobable binary digits is transmitted over a channel having infinite Band width using the rectangular signalling wave shown in figure1.

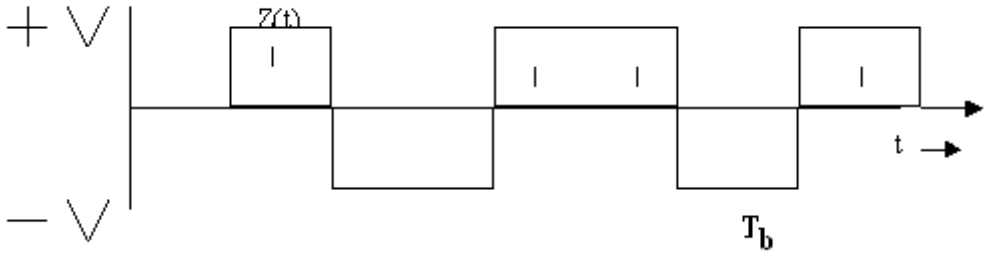

Figure 1:

The bit rate is $r_b$and the channel noise is white gaussian with a psd of $\eta/2$.

(a) Derive the structure of an optimum receiver for this signaling scheme.

(b) Derive an expression for the probability of error.

8. (a) Show that the syndrome S in block codes is the sum (modulo 2) of those rows of matrix H^T corresponding to the error location in the error pattern.

(b) Prove that the minimum distance of a linear block code is the smallest Hamming weight of nonzero code vectors in the code.

⋆ ⋆ ⋆ ⋆ ⋆

Code No: RR310405 **Set No.2**

III B.Tech. I Semester Supplementary Examinations, May -2005
DIGITAL COMMUNICATIONS
(Common to Electronics & Communication Engineering and Electronics & Telematics)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Establish the principles of flat top sampling with neat schematics. Hence explain the phenomenon of aperture effect and equalization.
   (b) A TV Signal has a bandwidth of 4.5 MHz. Determine the sampling rate and sampling intervals for
      i. minimum sampling
      ii. 10% under sampling and
      iii. 20% over sampling.
2. (a) If PAM and PPM systems are analogous to CW modulation schemes, in what way the pulse modulation is advantageous ?
   (b) What are the TDM aspects of T1 systems?
   (c) Distinguish between different types of transmission schemes for PAM signals, identifying the bandwidth requirements in each case?
3. (a) What is meant by Inter Symbol Interference (ISI)? And how it differs from Cross-talk in the PAM?
   (b) What is the ideal solution to obtain zero ISI and what is the disadvantage of this solution?
4. (a) Explain how eye patterns are used for monitoring the performance of base band PAM system.
   (b) What is the necessity of shaping transmitted signal spectrum.
5. 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 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.
6. In a single-integration DM system, the voice signal is sampled at a rate of 64kHz.The maximum signal amplitude is Amax=1.

(a) Determine the minimum value of the step size σ to avoid slope over load error.

(b) Determine the granular noise power if the voice signals bandwidth is 3.5 kHz.

(c) Assuming that the voice signal is sinusoidal, determine output signal power and SNR

(d) Determine the minimum transmission bandwidth.

7. (a) Show that the impulse response of a matched filter is a time reversed and delayed version of the input signal.

(b) Briefly explain properties of matched filter.

8. (a) Show that if g(x) is a polynomial of degree (n-k) and is a factor of x^n+1, then g(x) generates an (n,k) cyclic code in which the code polynomial for a data vector D is generated by v(x) = D(x)g(x).

(b) What are the hardware components required to implement a cyclic code encoder?

⋆ ⋆ ⋆ ⋆ ⋆

Code No: RR310405 **Set No.3**

III B.Tech. I Semester Supplementary Examinations, May -2005
DIGITAL COMMUNICATIONS
(Common to Electronics & Communication Engineering and Electronics & Telematics)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) State and prove Sampling Theorem as applicable to band limited signals.
   (b) Find the minimum sampling rate and Nyquist interval for the signals represented by
      i. m(t) and
      ii. $m^2(t)$ where $m(t) = \frac{Sin(300\pi t)}{\pi t}$

2. 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.

3. (a) What are the two key functional operations involved in correlative coding?
   (b) i. For the data stream 0010110, find the duo-binary decoded wave form and give the electrical representation of the data obtained at stages of decoding.
      ii. Verify that Duo-binary decoding results in bandwidth reduction during transmission by assuming the message sequence to be transmitted is an alternative 1/0 sequence.

4. (a) Explain how eye patterns are used for monitoring the performance of base band PAM system.
   (b) What is the necessity of shaping transmitted signal spectrum.

5. (a) Draw the block diagram of PCM Generator and explain each block.
   (b) Determine the Transmission Bandwidth in PCM.

6. (a) Explain the working of delta modulation system with neat block diagram.
   (b) Clearly bring out the difference between granular noise and slope over load error.

7. 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.

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

8. (a) Show that if g(x) is a polynomial of degree (n-k) and is a factor of x^n+1, then g(x) generates an (n,k) cyclic code in which the code polynomial for a data vector D is generated by v(x) = D(x)g(x).

(b) What are the hardware components required to implement a cyclic code encoder?

⋆ ⋆ ⋆ ⋆ ⋆

Code No: RR310405 **Set No.4**

III B.Tech. I Semester Supplementary Examinations, May -2005
DIGITAL COMMUNICATIONS
(Common to Electronics & Communication Engineering and Electronics & Telematics)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Establish the principles of flat top sampling with neat schematics. Hence explain the phenomenon of aperture effect and equalization.
   (b) A TV Signal has a bandwidth of 4.5 MHz. Determine the sampling rate and sampling intervals for
      i. minimum sampling
      ii. 10% under sampling and
      iii. 20% over sampling.
2. (a) Sketch and explain the typical waveforms of PWM signals, for leading edge, trailing edge and symmetrical cases.
   (b) Compare the analog pulse modulation schemes with CW modulation systems.
   (c) Show that a PAM signal can be expressed as the convolution of an instantaneously sampled signal, and a rectangular pulse p(t) of the form
   $$p(t) = \begin{cases} 1, & |t| \leq \tau/2 \\ 0 & elsewhere \end{cases}$$
3. (a) What is meant by Inter Symbol Interference (ISI)? And how it differs from Cross-talk in the PAM?
   (b) What is the ideal solution to obtain zero ISI and what is the disadvantage of this solution?
4. (a) What is meant by Synchronization in the base band PAM. What are the different methods to obtain Synchronization?
   (b) The T1 carrier system used in digital telephony multiplexes 24 voice channels based on 8-bit PCM. Each voice signal is usually put through a lowpass filter with cutoff frequency of about 3.4 KHz. The filtered voice signal is sampled at 8KHz. In addition, a single bit is added at the end of the frame for the purpose of synchronization. Calculate
      i. the duration of each bit
      ii. the resultant transmission rate and
      iii. the minimum required transmission bandwidth.
5. (a) Prove that the mean value of the quantization error is inversely proportional to the square of the number of quantization levels.
   (b) What is the function of a predictor in a DPCM system.

6. In a single-integration DM system, the voice signal is sampled at a rate of 64kHz.The maximum signal amplitude is Amax=1.
   (a) Determine the minimum value of the step size σ to avoid slope over load error.
   (b) Determine the granular noise power if the voice signals bandwidth is 3.5 kHz.
   (c) Assuming that the voice signal is sinusoidal, determine output signal power and SNR
   (d) Determine the minimum transmission bandwidth.

7. (a) Derive the expression for the probability of error in terms of the signal parameters, noise power spectral density, and the receiver parameters H (f) and threshold settings. Also mention the assumptions made in deriving the expressions for probability of errors.
   (b) n(t) is a zero mean Gaussian white noise with a psd of $\eta/2$. n_0 (T_b) is related to n(t) by
   $$n_0(T_b) = \int_0^{T_b} n(t).s(t)\,dt$$
   where S(t) =0 for t outside the interval [0, T_b] and $\int_0^{T_b} S^2(t)dt = Es$
   Show that E{$n_0(T_b)$}=0 and E{ $[n_0(T_b)]^2$}= $\eta\frac{Es}{2}$

8. Consider the convolutional encoder shown in the figure2 below. The message bits are shifted into the encoder two bits at a time.
   (a) Find the constraint length and the rate efficiency of the code.
   (b) Assume the initial content of the registers to be zero and find the code block for the input message block (110101).

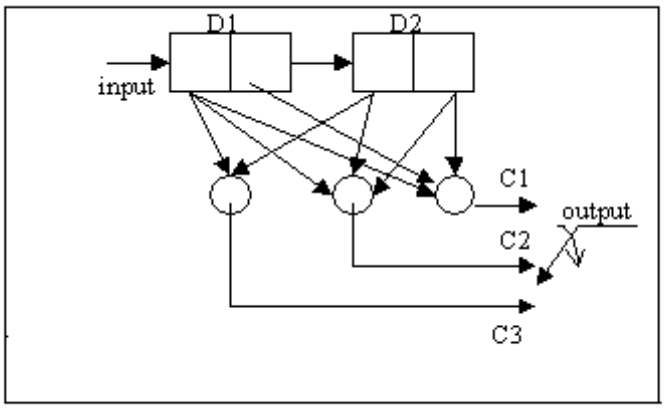

Figure 2:

⋆ ⋆ ⋆ ⋆ ⋆