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

III B.Tech. I Semester Regular Examinations, November -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

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1. (a) Establish the principles of flat top sampling with neat schematics. Hence explain the phenomenon of aperture effect and equalization. [10]
   (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. [6]

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
   $p(t) = \begin{cases} 1, & |t| \leq \tau/2 \\ 0 & elsewhere \end{cases}$ [5+5+6]

3. (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]

4. (a) Explain the necessity of Equalization in base band PAM systems. [8]
   (b) Find the duo-binary encoded sequence for the data sequence 011010. How it is detected? [8]

5. (a) Explain why quantizating noise could affect small amplitude signals in a PCM system more than large signals. With the aid of sketches show how tapered quantizing level could be used to counteract this effect? [10]
   (b) What are the applications of PCM. Give in detail any two applications. [6]

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. [8+8]

7. (a) With neat block diagram explain coherent detection of ASK waveform and hence show that probability of error Pe=Q ($\sqrt{\text{Eav}/\eta}$) Where Eav is the average signal energy/bit [Eav=Sav T_b]. [12]

   (b) Binary data is transmitted over a microwave link at a rate of 10^6 bits/Sec and the psd of noise at the receier is 10^{-10}Watts/Hz. Find the avarage carrier power required to maintain an average probability of error Pe$\leq 10^{-4}$ for coherent binary FSK. What is the required channel bandwidth? [4]

8. (a) Find the generator matrix of the H matrix given

$$H = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

   Find the first 5 code words. [10]

   (b) If the information word is A = 00101100111, find the code word T. [6]

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

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Establish the principles of flat top sampling with neat schematics. Hence explain the phenomenon of aperture effect and equalization. [10]
   (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. [6]

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
   $p(t) = \begin{cases} 1, & |t| \leq \tau/2 \\ 0 & elsewhere \end{cases}$ [5+5+6]

3. (a) Suggest a method to transmit data at the rate of r_b bits/sec. over channel with a bandwidth of $r_b/2$ Hz and explain it. [8]
   (b) A base band binary PAM system uses a signaling waveform $P_g(t) = \frac{Sin\ \pi\ r_b t}{\pi\ r_b t}$ to transmit binary data at a bit rate of r_b bps. The amplitude levels at the pulse generator out put are + 1V or – 1V, +1 if the in put bit is 1 and -1 if the input bit is 0. Sketch the waveform of the pulse generator output when the input bit string is 1001101. [8]

4. (a) Explain how eye patterns are used for monitoring the performance of base band PAM system. [8]
   (b) What is the necessity of shaping transmitted signal spectrum. [8]

5. For a PCM signal, determine L if the compression parameter μ=100 and the minimum SNR required is 45dB.Determine the output SNR with this value of L. Remember that L must be a power of 2,for binary PCM. Derive the formulae used. [16]

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. [4+4+4+4]

7. (a) Explain the function of a optimum Receiver medium for Binary digital modulation schemes. [8]

(b) Describe in detail with block diagram the binary ASK, PSK & FSK schemes . [8]

8. Briefly discuss about the following error control techniques.

(a) Linear block codes

(b) Parity check bits. [16]

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

III B.Tech. I Semester Regular Examinations, November -2005
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) With neat diagrams, explain the principle of working a sample and hold circuit. List out its applications. [8]

   (b) Show that $\sum_{R=-\infty}^{\infty} x(RT_s) = f_s \sum_{n=-\infty}^{\infty} X(nf_s)$, where x(t) is a signal band limited to f_1 , X(f) is the spectrum of x(t), and $f_s = \frac{1}{T_s} = 2f_1$ is the Nyquist sampling rate. [8]

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
   $p(t) = \begin{cases} 1, & |t| \le \tau/2 \\ 0 & elsewhere \end{cases}$ [5+5+6]

3. (a) Why the overall transfer function of the duo-binary filter is called as Half-cycle cosine function. [8]

   (b) Give the Impulse response of the duo-binary filter and sketch the amplitude and phase response. [8]

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:
   $$p_r(kT_b) = p_r(k) = \begin{cases} 0.2 & k = 1 \\ 0.8 & k = 0 \\ 0.2 & k = -1 \end{cases}$$
   $$p_{r(k)} = 0 \, for \, |k| > 1$$

   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]

5. A message signal m(t) is transmitted by binary PCM without compression .If the SNR is required to be at least 47dB, determine the minimum value of L required, assuming that m(t) is sinusoidal. Determine the SNR obtained with this minimum L. Derive the formulae used. [16]

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. [8+8]

7. (a) Explain correlation receiver with block diagram. Also explain why the correlation receiver is also called as Integrate and Dump filter. [8]
   (b) A received signal is ± 1 mv for T_b second intervals with equal probability. The signal is accompanied by white Gaussian noise with a psd of 10^{-10} Watt/Hz. The receiver integrates the signal plus noise synchronously for T_b second duration and decodes the signal by comparing the integrator output with 0.
      i. Find the maximum signaling rate (Minimum value of T_b) such that Pe=$10^{-4.}$
      ii. If actual signalling takes place at $\frac{1}{2}$ the rate found in (i), what is the signal amplitude required to maintain Pe=10^{-4} ? [8]

8. Briefly discuss about the following error control techniques.
   (a) Linear block codes
   (b) Parity check bits. [16]

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

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

Answer any FIVE Questions
All Questions carry equal marks

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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 $m(t) = \frac{Sin(300\pi t)}{\pi t}$ [12+4]

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
   $p(t) = \begin{cases} 1, & |t| \leq \tau/2 \\ 0 & elsewhere \end{cases}$ [5+5+6]

3. (a) What are the two key functional operations involved in correlative coding? [8]
   (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. [4]
      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]

4. (a) Explain the necessity of Equalization in base band PAM systems. [8]
   (b) Find the duo-binary encoded sequence for the data sequence 011010. How it is detected? [8]

5. (a) Draw the block diagram of PCM Generator and explain each block.
   (b) Determine the Transmission Bandwidth in PCM. [8+8]

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 [8]

(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. [8]

7. (a) Show that the probality of bit error of a matched filter receiver is given by Pe = ½ erfc $\sqrt{}$ Eb/No. [8]

(b) Specify a matched filter receiver for the signal S(t) shown in Figure1 and Sketch the filter output as a function of time. [8]

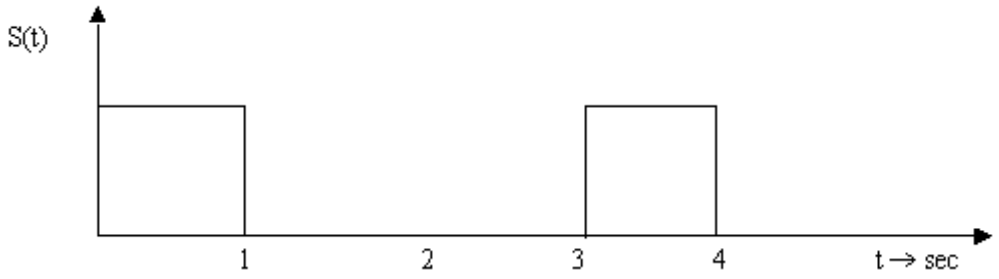

Figure 1:

8. Draw the state diagram, tree diagram and trellis diagram for k=3, rate 1/3 code generated by $g_1(x) = 1+x^2$, $g_2(x) = 1+x$, $g_3(x) = 1+x+x^2$. [16]

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