Reg. No.

EC6T2/TE6T2

Sixth Semester B.E. Degree Examination, August 2001

Electronics & Communication /Telecommunications

Digital Communication

9

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Explain with a neat block diagram the essential and nonessential features of a digital communication system. **(6 Marks)**

(b) Obtain an expression for Fourier transform of a sampled signals, assume flat top sampling. **(6 Marks)**

(c) A signal $g(t)$ consists of two frequency components $f_1 = 3.9KHz$ and $f_2 = 4.1KHz$ in such a relationship they cancel out each other when $g(t)$ is sampled at the instants $t = 0, T, 2T.....$ where $T = 125\mu s$. The signal $g(t)$ is defined by $g(t) = \cos\left[2\pi f_1 t + \frac{\pi}{2}\right] + A\cos[2\pi f_2 t + \Phi]$ Find the values of amplitude A and phase Φ of the second frequency component. **(8 Marks)**

2. (a) Derive an expression for the ratio of average signal power to average quantization noise power in a PCM system. **(6 Marks)**

(b) Show that, with a nonuniform quantizer, the mean-square value of the quantization error is approximately equal to $\frac{1}{12}\sum_i \Delta_i^2 p_i$ where Δ_i is the i^{th} step size and p_i is the probability that the input signal amplitude lies within the i^{th} interval. Assume that step size is small compared with the excursion of the i/p signal. **(8 Marks)**

(c) Explain the need for nonuniform quantization. Also, explain μ - Law and A - Law companding. **(6 Marks)**

3. (a) Explain the concenpt of Time division multiplexing of PAM signals by drawing a relevant block diagram. **(6 Marks)**

(b) A DM system is designed to operate at 3 times the Nyquist rate for a signal with a 3-KHz bandwidth. The quantizing step size is 250 mV.

(i) Determine the maximum amplitude of a 1-KHz input sinusoid for which the delta modulator does not show slope overload.

(ii) Determine the postfiltered output SNR for the signal of part (i) **(8 Marks)**

(c) Explain with relevant mathematical relations a DM transmitter and receiver. **(6 Marks)**

4. (a) Consider a test signal $m(t)$ defined by a hyperbolic tangent function. $m(t) = A\tan h(\beta t)$ where A and B are constants. Determine the minimum step size Δ for delta modulation (DM) of this signal, which is required to avoid slope overload. **(7 Marks)**

(b) Explain Intersymbol interference (ISI) by drawing a block diagram of a binary baseband transmission system. Also explain Nyquist solution used for curing ISI. curing ISI. **(8 Marks)**

(c) What is an equalizer? Explain an adaptive equalizer? **(5 Marks)**

Contd.... 2

5. (a) Discuss the basic issues involved in the design of a regenerative repeater for pulse code modulation. (5 Marks)

(b) The binary data stream 001101001 is applied to the input of a duobinary system. Construct the duobinary encoder output and corresponding receiver output, without a precoder. (6 Marks)

(c) Show that the impulse response of a matched filter is a time reversed and delayed version of the input signal. (9 Marks)

6. (a) Sketch the waveform of the MSK signal for the sequence 101101. Assume that carrier frequency is 1.25 times the bit rate. (7 Marks)

(b) Find the output of the matched filter and determine the maximum value of $(\frac{S}{No})$ if the input S(t) is a rectangular pulse of amplitude A and duration T. (8 Marks)

(c) Briefly explain the properties of a matched filter. (5 Marks)

7. (a) A polar binary signal $S_i(t)$ is a +1V or -1V pulse during the interval (0,T). Additive white noise with power spectral density $\frac{\eta}{2} = 10^{-5} W/Hz$ is added to the signal. Determine the maximum bit rate that can be sent with a bit error probability of $P_e \leq 10^{-4}$. Take $Q[3.71] = 10^{-4}$ where $Q(Z) = \frac{1}{\sqrt{2\pi}} \int_z^\infty e^{-\lambda^2/2} d\lambda$ (7 Marks)

(b) Derive an expression for probability of bit error of a binary coherent FSK receiver (6 Marks)

(c) An on off binary system uses the pulse waveforms

$$s_i(t) = \begin{cases} s_1(t) = A \sin(\frac{\pi t}{T}), & 0 \leq t \leq T \\ s_2(t) = 0, & 0 \leq t \leq T \end{cases}$$

Let A = 0.2 mv and $T = 2\mu s$. Additive white noise with a power spectral density $\frac{\eta}{2} = 10^{-15}$ W /Hz is added to the signal. Determine the probability of error when $P(s_1) = P(s_2) = 1/2$. Take $Q[\sqrt{10}] = 7.83 \times 10^{-4}$. (7 Marks)

8. Write short notes on the following :

(i) Limitations of a Delta modulator

(ii) Line codes

(iii) Maximum Likelihood estimator

(iv) Eye patterns (5x4=20 Marks)

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EC/TE6T2

Reg. No.

Sixth Semester B.E. Degree Examination, February 2002

Electronics and Communication /Telecommunications Engineering

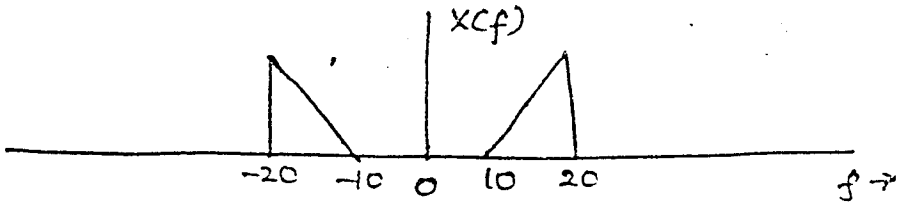
Digital Communication

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Permitted to use Q function or erfc function table.

1. (a) State and prove sampling theorem for lowpass signals. (8 Marks)

(b) A bandpass signal with a spectrum shown in figure is ideally sampled. Sketch the spectrum of the sampled signal when f_s = 20, 30 and 40Hz. Indicate if and how the signal can be recovered.



(8 Marks)

(c) What are the advantages of digital communication compared to analog communication. (4 Marks)

2. (a) Derive an expression for signal to quantization noise power ratio in a PCM system. (6 Marks)

(b) Explain the working of DPCM transmitter and receiver. (8 Marks)

(c) 24 analog signal each having a BW of 15KHz are to be time division multiplexed and transmitted via PAM/AM. A guard band of 5KHz is required for signal reconstruction from the PAM samples of each signal.

i) Determine the sampling rate for each channel.

ii) Determine the transmission bandwidth. (6 Marks)

3. (a) What is ISI? Explain baseband pulse shaping for zero ISI. (8 Marks)

(b) Explain the need for a precoder in a duobinary signalling. For input binary data 1011101 obtain the output of precoder and output of duobinary coder. Explain how data can be detected at the receiver. (8 Marks)

(c) The output of a digital computer is at a rate of 64kbps. If the roll of factor (i) $\alpha = 1$ (ii) $\alpha = 0.5$ (iii) $\alpha = 0.25$ (iv) $\alpha = 0$, find the band width required to transmit the data in each case. (4 Marks)

4. (a) Explain the desirable properties of line code. (4 Marks)

(b) Binary data is given by 101101 represent the data using

i) Rz-polar ii) NRZ unipolar iii) RZ Bipolar iv) Bi-phase format. (4 Marks)

Contd... 2

Design a binary base band PAM system to transmit data at a bit rate of 9600 bits/sec, with a bit error probability less than 10^{-4}. The channel response is given by

$$Hc(f) = \begin{cases} 10^{-3} & \text{for } |f| < 2400 \\ 0 & \text{else where} \end{cases}$$

The noise power spectral density is $Gn(f) = 10^{-4} watt/HZ$. (12 Marks)

5. (a) Explain coherent and noncoherent detection of binary FSK waves. (5 Marks)

(b) Derive an expression for the probability of bit error in a PSK system. (5 Marks)

(c) Explain the working of QPSK transmitter and receiver. (10 Marks)

6. (a) Show that the impulse response of a matched filter is a time reversed and delayed version of the input signal. (10 Marks)

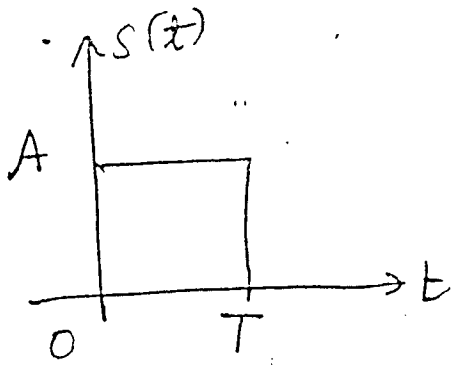
(b) Briefly explain the properties of matched filter. (5 Marks)

(c) A bipolar signal Si(t) is a+1V or -1V pulse during the interval (O,T). Additive white Gaussian noise of $n/2 = 10^{-5} W/HZ$ is added to the signal. Determine the maximum bit rate that can be sent with $P_e \leq 10^{-4}$. Take $Q[3.71] = 10^{-4}$. (5 Marks)

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

(b) Explain minimum shift keying. (6 Marks)

(c) Find the output of a matched filter for a rectangular tube input shown below :



(6 Marks)

8. Write short notes on the following : (4×5=20 Marks)

i) Delta modulation

ii) Adaptive equalization

iii) Eye pattern

iv) Non-uniform quantization

(3)

EC/T&T2

(95)

Reg. No.

Sixth Semester B.E. Degree Examination, July/August 2002

Electronics and Communication /Telecommunications Engineering

Digital Communication

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Time: 3 hrs.] [Max Marks: 100

Note: *1. Answer any FIVE full questions.*
2. Use of complementary error functions tables permitted.

1. (a) With the help of a neat block diagram, explain digital communications system. Bring out merits and demerits of digital communication over analog communication. (6+4 Marks)

   (b) A signal $x(t) = 2Cos400\pi t + 6Cos640\pi t$ is ideally sampled at $\int_s = 500Hz$. The sampled signal is passed through an ideal LPF with cut-off frequency of 400Hz.

   i) Sketch the frequency spectrum of the sampled wave.

   ii) State what frequency components will appear at the output? (4+2 Marks)

   (c) What is "Aperture Effect"? How is it eliminated? (2+2 Marks)

2. (a) With neat diagra explain the operation of DM transmitter and receiver. (8 Marks)

   (b) Derive an expre ion for SNR of DM system. (6 Marks)

   (c) A DM system is tested with a 10KHz sinusoidal signal 1 volt peak to peak at the input. It is sampled at 10 times the Nyquist rate.

   i) What is the step size required to prevent slope overload?

   ii) What is the corresponding SNR? (4+2 Marks)

3. (a) For a given binary sequence 111000110101, draw the digital format waveforms corresponding to

   i) Polar Manchester coding waveform.

   ii) Bipolar NRZ waveform.

   iii) 8-ary signalling waveform. (2+2+3 Marks)

   (b) Explain T1 carrier system with compounding details. (6 Marks)

   (c) Discuss the intersymbol interference problem and explain how Nyquist pulse shaping criterion is helpful in eliminating it. (7 Marks)

4. (a) Discuss base band transmission of M-ary data. (6 Marks)

   (b) What is "Eye pattern"? How is it helpful in understanding the ISI problem? Explain with a suitable binary sequences. (4+4 Marks)

   (c) Write a brief note on "Equalization". (6 Marks)

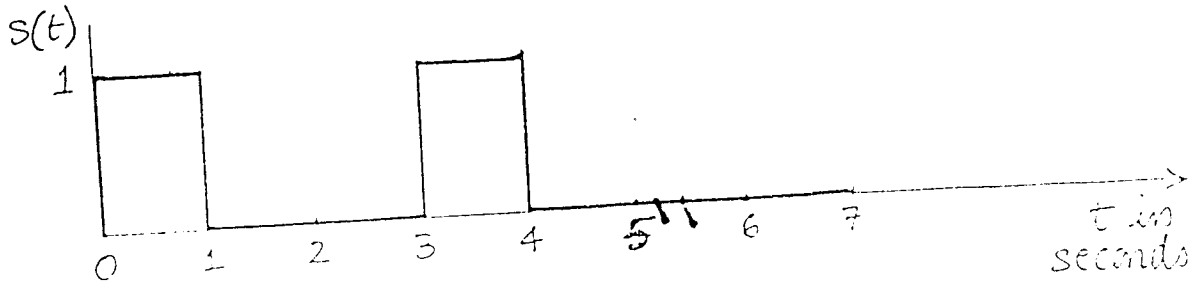
5. (a) Show that the probability of bit error of a matched filter receiver is given by

$$P_e = \frac{1}{2}\, erfc \sqrt{\frac{E_b}{N_o}}$$

(8 Marks)

Contd.... 2

(b) Specify a matched filter receiver for the signal S(t) shown in figure below and sketch the filter output as a function of time. (6 Marks)



(c) With a neat diagram, explain the generation of BPSK waveform using ring modulator. (6 Marks)

6. (a) With the help of a block diagram, explain the operation of QPSK transmitter. Indicate the QPSK output phase for different Q and I binary input and the phasor diagram. For an assumed input binary data give the QPSK output waveform. (6 Marks)

(b) With neat block diagram, explain coherent detection of ASK waveform. (5 Marks)

(c) Binary data is transmitted over a microwave link at a rate of 10^6 bits/sec and the PSD of noise at the receiver input is 10^{-10} watts/Hz. Find the average carrier power required to maintain an average probability of error $P_e \leq 10^{-4}$ for coherent binary FSK. What is the required channel bandwidth? (6 Marks)

7. (a) With neat block diagram, explain the transmitter and receiver of slow frequency hop spread M-ary frequency shift keying system. (6 Marks)

(b) A slow FH.MFSK system has the following parameters.

The number of bits/MFSK symbol = 4
The number of MFSK symbols per hop = 5

Calculate the processing gain of the system in decibels. (4 Marks)

(c) Distinguish between slow-frequency hopping and fast-frequency hopping. (4 Marks)

8. Write explanatory notes on:

a) Bandwidth of digital data and bandwidth dilemma.

b) DPCM.

c) Duobinary signalling.

d) Properties of Matched Filter. (4×5=20 Marks)

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EC 612

Reg. No.

Sixth Semester B.E. Degree Examination, January/February 2003

Electronics and Communication /Telecommunications Engineering

Digital Communication

12

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Error function table will be supplied.
3. Any missing data may suitable be assumed with appropriate comments.

1. (a) With a neat block diagram, briefly describe the basic signal processing operations involved in a digital communication system. (7 Marks)

   (b) State and prove the sampling theorem for an analog signal, g(t) of finite energy and draw the spectrum of the analog signal and the sampled signal for a sampling rate $f_s = 2W$, where W is the highest frequency component of the signal. Assume that g(t) is bandlimited to W Hz. (8 Marks)

   (c) The signal $g(t)$ $(2\pi t)cos(200\pi t)$ is sampled at the rate of 250 samples per second.

   i) Determine spectrum of the sampled signal.

   ii) What is the Nyquist rate for the signal $g(t)$? (5 Marks)

2. (a) What are the advantages of digital representation of analog signals? (4 Marks)

   (b) What is the difference between PCM & DPCM? Briefly explain the operation of the DPCM system with a neat block diagram. (11 Marks)

   (c) Consider a DPCM system whose transmitter uses a first order predictor optimized in the minimum mean-square sense. Calculate the prediction gain of the system for the following values of correlation co-efficient for the message signal.

$$(i)\ \rho_1 = \frac{R_x(1)}{R_x(0)} = 0.825 \ ; (ii)\ \rho_1 = \frac{R_x(1)}{R_x(0)} = 0.95$$

   ρ_1 equals the autocorrelation function of the message signal for lag T, normalised with respect to the mean-square value of the signal. (5 Marks)

3. (a) What is delta modulation interms of DPCM? With a neat illustration explain how DM provides a staircase approximation to the oversampled version of an input baseband signal. (6 Marks)

   (b) Explain briefly the following as applied to DM systems:

   i) Scope-overload distortion

   ii) Granular noise. (6 Marks)

   (c) What is adaptive delta modulation? Explain the transmitter and receiver schemes of an ADM system. (8 Marks)

4. (a) State and prove Nyquist criterion for distortionless baseband transmission. (8 Marks)

(b) Discuss the features of ideal Nyquist channel. (6 Marks)

(c) A binary PAM wave is to be transmitted over a low-pass channel with an absolute maximum bandwidth of $75KHz$. The bit duration is 10 microseconds. Find a raised cosine spectrum that satisfies these requirements. (6 Marks)

5. (a) What is digital modulation? How are digital modulation techniques classified? With neat block schematics for illustration explain briefly the following:

i) BINARY PSK Transmitter.

ii) COHERENT BINARY PSK Receiver. (12 Marks)

(b) An FSK system transmits binary data at a rate of 2.5×10^6 bits per second. During the course of transmission, white Gaussion noise of zero mean and power spectral density 10^{-20} watts per hertz is added to the signal. In the absence of noise, the amplitude of the received sinusoidal wave for digit 1 or 0 is one microvolt. Determine the average probability of symbol error assuming coherent detection. (8 Marks)

6. (a) What do you mean by an 'OPTIMUM RECEIVER' With reference to a digital modulation scheme? Write the scheme of a correlation receiver and describe its features. (6 Marks)

(b) A bandpass data transmission scheme use a PSK signaling scheme with

$$s_2(t) = A cos \omega_c t, \quad o \leq t \leq T_b; \; \omega_c = \frac{10\pi}{T_b}$$

$$s_1(t) = -A cos w_c t, \quad o \leq t \leq T_b; \; T_b = 0.2 m Sec$$

The carrier amplitude at the receiver input is one millivolt and the power spectral density of the additive White Gaussian noise at the input is 10^{-11} watt per hertz. Assume that an ideal correlation receiver is used. Calculate the average bit error rate of the receiver. (8 Marks)

(c) Estimate the power spectral density of the binary PSK signal. (4 Marks)

7. (a) Write the equations for the transfer function and impulse response of a matched filter. What is the reason for calling the filter as a matched filter? Support your answer with necessary equations and illustrations. (5 Marks)

(b) What is spread spectrum communication? What is its primary advantage? What are the commonly used spread spectrum techniques? (5 Marks)

(c) With necessary sketches for illustration, describe an idealised model of baseband spread spectrum transmitter and receiver. (10 Marks)

8. Briefly explain the following: (6 Marks)

(a) Binary data formats. (7 Marks)

(b) Correlative coding signaling scheme. (7 Marks)

(c) Adaptive equaliser.

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USN

Sixth Semester B.E. Degree Examination, July/August 2005

Electronics and Communication /Telecommunications Engineering

Digital Communications

Time: 3 hrs.] [Max.Marks : 100

Note: 1. *Answer any FIVE full questions.*
2. *All questions carry equal marks.*

1. (a) Bring out the salient differences between analog and digital communication systems. (4 Marks)

   (b) With a neat block diagram explain the variqus elements of a digital communication system. (6 Marks)

   (c) Describe in detail the process of amplitude modulation when a rectangular pulse h(t) is modulated by an input signal g(t). Obtain the overall frequency domain expression of the PAM signal. (6 Marks)

   (d) Explain how practical sampling is different from ideal sampling. (4 Marks)

2. (a) With neat block schematics explain the process of differential pulse code modulation giving emphasis to the need for using a prediction filter. (10 Marks)

   (b) Explain the concept of TDM. (4 Marks)

   (c) A PCM system uses uniform quantizer and a 7-bit encoder with bit rate of 50 MBPs. Find maximum message land width. Find the output SNR for f_m of 1MHz. (6 Marks)

3. (a) Explain how quantizing error is introduced in digital communication system. Obtain the signal to quantizing noise ratio at the output for sinusoidal modulation. (10 Marks)

   (b) Describe how ISI is introduced in digital systems. Obtain the raised cosine spectrum for tho analysis of ISI problems. (10 Marks)

4. (a) Explain how ISI can be utilized to increase the signalling rate with reference to duobinary signalling scheme. (10 Marks)

   (b) Demonstrate the operation of duobinary scheme for transmitting the data stream 0010110. (5 Marks)

   (c) Explain how eye patterns are used to measure the amount of ISI. (5 Marks)

5. (a) Distinguish between ASK, PSK and FSK digital modulation techniques. (6 Marks)

   (b) Describe the working of a non-coherent ASK system with neat block diagram. (9 Marks)

   (c) Binary data is transmitted over a communication link of bandwidth 3000Hz. Maximum SNR measured is 6dB. Find maximum signalling rate and probability of error, Pe, for coherent ASK. If data rate is reduced to 300 bps show that Pe reduces drastically. (5 Marks)

Contd.... 2

6. (a) With a neat block schematic describe the operation of a differentially coherent PSK. (6 Marks)

(b) For an input stream of 110100011 explain the encoding and decoding process when DPSK is used. (4 Marks)

(c) Describe the concept of minimum shift keying, MSK. Show that MSK is another example of quadrature multiplexing. Draw coded waveforms for debits 00, 10, 11, and 01. (10 Marks)

7. (a) Describe how an optimum receiver is formulated. Derive the expression for maximised output SNR. (10 Marks)

(b) State the important properties of matched filters. (4 Marks)

(c) Obtain the output Fourier transform of a matched filter for a rectangular pulse. (6 Marks)

8. (a) Describe the concept of spread spectrum systems. (6 Marks)

(b) With a neat block diagram explain the working of a frequency hopped transmitter - receiver combination. (10 Marks)

(c) Show how fast-frequency hopping improves the system performance. (4 Marks)

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EC/TE6T2

USN

Sixth Semester B.E. Degree Examination, January/February 2004

Electronics and Communication /Telecommunications Engineering

Digital Communication

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Use of erfc tables permitted.

1. (a) State and prove sampling theorem for band-pass signals. (8 Marks)

   (b) The signal $g(t) = 10.cos\ 20\pi t \cdot cos 200\pi t$ is sampled at the rate of 250 samples/sec.

   i) Determine the spectrum of the resulting sampled signal.

   ii) Specify the cut-off frequency of the ideal reconstruction filter so as to recover $g(t)$ from its sampled version.

   iii) What is the Nyquist rate for $g(t)$? (4+1+1 Marks)

   (c) What is "aliasing error"? Explain in brief any two corrective measures to remover the effect of aliasing in practice. (2+2+2 Marks)

2. (a) What is the necessity of non-uniform quantization? Explain the two companding methods used in practice. (3+3+3 Marks)

   (b) With a neat block diagram explain the operation of a PCM transmitter receiver system. (7 Marks)

   (c) A telephone signal band-limited to 4kHz is to be transmitted by PCM. The signal-to-quantization noise is to be at least 40 dB. Find the number of levels into which the signal has to be encoded. Also find the band width of transmission. (3+1 Marks)

3. (a) Discuss the various properties of line codes (digital formats) (8 Marks)

   (b) For a given binary sequence 1011000110, draw the digital format waveforms corresponding to

   i) Unipolar Manchester code

   ii) Bipolar RZ waveform

   iii) NRZ polar signalling scheme. (6 Marks)

   (c) What is the necessity of a precoder in Duo-binary signalling scheme? Explain with a suitable example. (6 Marks)

4. (a) With a neat block diagram, explain the base-band binary transmission and reception system. (8 Marks)

   (b) What is "Eye pattern"? What is its use in digital communication systems? (6 Marks)

Contd.... 2

(c) Explain briefly "Adaptive equalization". (6 Marks)

5. (a) With neat block diagrams, explain how a BASK wave can be generated and detected. (6 Marks)

(b) Explain "Integrate and dump filter" with the help of a block diagram. (8 Marks)

(c) State and prove the properties of matched filter. (6 Marks)

6. (a) The bit stream 1011100011 is to be transmitted using DPSK technique. Determine the encoded sequence and transmitted phase sequence. Also draw the block diagram of the modulator and demodulator for the same and explain. (2+2+4+4 Marks)

(b) Obtain an expression for the probability of error of a BFSK system. (8 Marks)

7. (a) Binary data is transmitted over an RF band pass channel having a bandwidth of 10 MHz at a rate of 4.8 megabits/sec, with a 1 mV carrier amplitude using ASK technique. The channel has a noise psd of $10^{-15}\ Watts/Hz$. Find the error probability of the system. (6 Marks)

(b) A fast FH/MFSK system has the following parameters :

The number of bits per MFSK symbol = 4
The number of hops per MFSK symbol = 4

Calculate the processing gain of the system. (4 Marks)

(c) Explain the aplication of spread spectrum technique to

i) Code-division multiple access ii) Multipath suppression (5+5 Marks)

8. Write explanatory notes on :

a) Aperture effect

b) Delta modulation

c) Raised cosine spectrum

d) TDM (5×4=20 Marks)

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EC/TE6T2

USN | | | | | | | | | | |

Sixth Semester B.E. Degree Examination, July/August 2004

Electronics and Communication /Telecommunications Engineering

Digital Communication

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Use of Error Function tables permitted.

1. (a) State and prove sampling theorem for low pass signals. (6 Marks)

(b) The signals $g_1(t) = 10cos100\pi t$ and $g_2(t) = 10cos50\pi t$ are both sampled at times $t = nT_s$ with a sampling rate $fs = \frac{1}{T_s} = 75$ samples/sec. Show that the two sequences of samples obtained are identical in both time and frequency domains. (3+5 Marks)

(c) Discuss the advantages and disadvantages of digital communication over analog communication. (6 Marks)

2. (a) With a neat block diagram, explain the operation of a DPCM transmitter receiver system. (8 Marks)

(b) With a neat block diagram, explain the three major operations performed in a regenerative repeater in a PCM system. (4 Marks)

(c) Show that for large values of μ = A, the μ-law and A-law have the same companding gain G_c. (8 Marks)

3. (a) With a neat block diagram, explain the operation of time-division multiplexing of PAM signals. (6 Marks)

(b) Six independent message sources of band widths w, w. 2w, 2w, 3w and 3w Hz are to be transmitted on a time division multiplexed basis using a common communication channel.

i) Set up a scheme for accomplishing this multiplexing requirement, with each message signal sampled at its Nyquist rate.

ii) Determine the minimum transmission band width of the channel. (8 Marks)

(c) For the binary sequence 0110100011, draw the unipolar, polar and bipolar formats for both RZ and NRZ types. (6 Marks)

4. (a) What is 'Raised - Cosine -Frequency - Spectrum'? What is its necessity? (8 Marks)

(b) An analog signal is sampled, quantized and encoded into a binary PCM wave. The number of representation levels used is 128. A synchronizing pulse is added at the end of each code word representing a sample of the analog signal. The resulting PCM wave is transmitted over a channel of band width 12kHz using a binary PAM system with a raised cosine spectrum. The roll - off factor is unity.

i) Find the rate (in bits/sec) at which the information is transmitted through the channel.

ii) Find the rate at which the analog signal is sampled. What is the maximum possible value for the highest frequency component of the analog signal? (7 Marks)

(c) Discuss the usefulness of EYE PATTERN in digital communication system. (5 Marks)

Contd.... 2

5. (a) With neat diagrams, explain how a coherent binary FSK wave can be generated and detected. (8 Marks)

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

(c) Consider the signal S(t) show in figure 5(c).

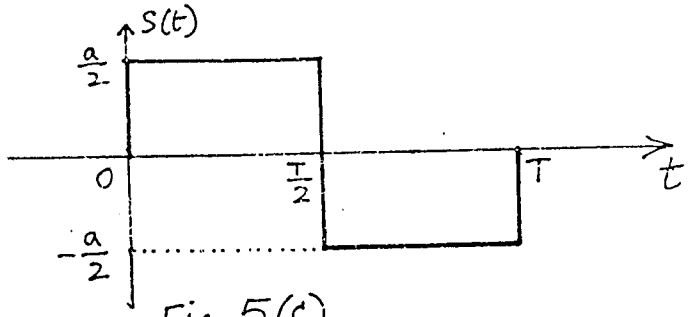

Fig. 5(c)

i) Determine the impulse response of a filter matched to this signal and sketch it as a function of time.

ii) Plot the matched filter output as a function of time.

iii) What is the peak value of the output? (5 Marks)

6. (a) Obtain an expression for the probability of bit error of a binary ASK system. (8 Marks)

(b) A bandpass data transmission scheme uses PSK signaling with

$$\left.\begin{array}{l} S_1(t) = -A cos t\omega_c t \\ S_2(t) = A cos t\omega_c t \end{array}\right\} 0 \leq t \leq T_b$$

with $\omega_c = \frac{10\pi}{T_b}$ and $T_b = 0.2m - sec.$. The carrier amplitude at the receiver is 10^{-3} volts and the PSD of the additive white Gaussian noise is 10^{-11} watts/Hz. Assume that an ideal correlator receiver is used. Calculate the probability of bit error at the receiver. (6 Marks)

(c) Binary data are transmitted over a microwave link at the rate of 10^6 bits/sec and the power spectral density of the noise at the receiver input is 10^{-10} watts/Hz. Find the average carrier power required to maintain an average probability of error $P_e \leq 10^{-4}$ for non coherent binary FSK. What is the required channel bandwidth? (6 Marks)

7. (a) Define 'SPREAD-SPECTRUM'. Briefly explain the necessity of spread spectrum modulation. (4+6 Marks)

(b) Discuss the advantages of fast frequency hopping over slow frequency hopping. (5 Marks)

(c) Explain the different types of 'JAMMERS' encountered in practice. (5 Marks)

8. Write explanatory notes on :

i) Bandwidth of digital data and bandwidth dilemma. (4 Marks)

ii) T1 system. (8 Marks)

iii) Duo-binary signalling scheme. (8 Marks)

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EC/TE6T2

USN | | | | | | | | | | |

Sixth Semester B.E. Degree Examination, January/February 2005

Electronics and Communication /Telecommunications Engineering.

Digital Communications

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. All questions carry equal marks.
3. Use of complementary error function tables permitted.

1. (a) State and prove sampling theorem for bandpass signals. **(7 Marks)**

(b) A signal $x(t) = 10cos(500\pi t)\ cos^2(800\pi t)$ is ideally sampled at $f_s = 2000$ samples/sec. The signal is passed through an ideal low pass filter with a cut off frequency 1000 Hz.

i) What is the Nyquist rate?

ii) Sketch the frequency spectrum of the sampled wave

iii) State what frequency components will appear at the output of the filter. **(8 Marks)**

(c) What is bandwidth dilemma encountered in transmission of digital signals? **(5 Marks)**

2. (a) Distinguish between mid rises and midtread quantizers. **(4 Marks)**

(b) What do you mean by "REGENERATION" in PCM systems? With a neat block diagram explain the three major processes involved in regeneration. **(9 Marks)**

(c) A signal $x(t) = 3sin500t$ is sampled and quantized using 10 bit PCM.

i) Find the (SNR) in dB, step size and the number of levels.

ii) If the above signal is quantized using N-bit PCM, find N required to achieve a (SNR) of atleast 50 dB. Also find the new number of levels and the new value of step size. **(7 Marks)**

3. (a) What are slope overload error and quantization noise (granular noise) in DM systems? Derive the condition to prevent overloading for a sinusoial input variation. **(10 Marks)**

(b) A DM system is designed to operate at 15 times the Nyquist rate for signal with a 3 kHz bandwidth. The quantizing step size is 250 mV.

i) Determine the maximum amplitude of a 3 kHz input sinusoid for which delta modulator does not show slope overload.

ii) Determine the post filtered $(SNR)_0$ for the signal of part (i). **(6 Marks)**

(c) Compare DM with PCM. **(4 Marks)**

4. (a) Explain T-1 carrier system used for long distance data transmission with special reference to the companding details and bit-rates. **(8 Marks)**

Contd.... 2

(b) For a bit-steam of 101100011011, show the encoded waveforms for

i) Polar NRZ signalling scheme

ii) Bipolar RZ signalling scheme

iii) Polar Manchester isgnalling scheme

iv) 4-level natural coding scheme

v) 8-level Gray code signalling scheme (7 Marks)

(c) Discuss the various properties of digital formats. (5 Marks)

5. (a) Derive the necessary condition in base-band binary transmission for achieving zero ISI. (7 Marks)

(b) What is raised cosine spectrum? What is its necessity? Briefly explain the features of raised cosine spectrum. (7 Marks)

(c) A communication channel of bandwidth 75 kHz is required to transmit binary data at a rate of 100 kilo-bits/sec. using raised cosine pulses. Determine the roll-off factor and specify the complete raised cosine spectrum. (6 Marks)

6. (a) With neat diagrams explain the DUO-BINARY signalling scheme and obtain the transfer function of the DUO-BINARY filter. (8 Marks)

(b) What is PRECODING with respect to duo-binary signalling? What is its necessity? (5 Marks)

(c) A binary data 0010110 is applied to the input of a duobinary coder.

i) Illustrate error propagation

ii) Construct the precoder output

iii) Determine the duo binary coder output with and without precoder. (7 Marks)

7. (a) Show that the impulse response of a matched filter is a time reversed and time shifted version of the input signal. (8 Marks)

(b) Explain generation and coherent detection of BPSK waves. (6 Marks)

(c) The bit stream 1011100011 is to be transmitted using DPSK. Determine the encoded sequence and the transmitted phase sequence. Draw the block diagram of the modulator and demodulator for the same. (6 Marks)

8. (a) Obtain an expression for probability of error in binary ASK system using coherent detection. (8 Marks)

(b) A received PSK signal is $\pm 1mV$ for T_b secs interval with equal probability. The signal is accompanied by WGN with a PSD of 10^{-10} Watts/Hz. The receiver integrates the signal and noise synchronously for T_b secs duration and decodes the signal by comparing the decoder output with zero. Find the minimum value of T_b such that $P_e = 10^{-4}$ (5 Marks)

(c) With neat block diagrams, explain the transmitter and receiver portions of frequency hopped spread spectrum system. (7 Marks)

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NEW SCHEME

EC61

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Sixth Semester B.E. Degree Examination, July/August 2005

EC/TE/ML/BM

Electronics and Communication /Telecommunications Engineering

Digital Communication

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Explain the term quadrature sampling of band pass signal with help of spectrum and block diagrams. (6 Marks)

   (b) The signal $g(t) = 10\ cos\ (20\pi t)\ cos(200\pi t)$ is sampled at the rate of 250 samples per second.

   i) Determine the spectrum of the resulting sampled signal and sketch

   ii) Specify the cut-off frequency of the ideal reconstruction filter so as recover f(t) from the sampled version and also find the Nyquist rate. (6 Marks)

   (c) The spectrum of signal $g(t)$ is defined as

   $$G(f) = \frac{1}{\sqrt{1+f^2}}$$

   This signal is passed through a pre-alias filter before sampling having a transfer function $H(f)\frac{1}{\sqrt{(f^8)}}$. The resulting signal from the pre-aliasfilter is sampled at 2.5 sample/sec. Calculate the SDR. Compare your result when pre-alias filter is not used. (8 Marks)

2. (a) Explain the following terms with reference to PCM and bring out the importance

   i) Dquantizing ii) Synchronization (6 Marks)

   (b) A binary PCM system uses polar singalling with symbols '1' and '0' represented by $+\frac{a}{2}$ and $-\frac{a}{2}$ volts. The additive noise is a Gaussian process with zero mean and noise power spectral density No/2. Evaluate the average probability of symbol error. (6 Marks)

   (c) Explain the T1 - carrier system and bringout the commanding characteristic of the quantizer in this scheme. (8 Marks)

3. (a) Explain and prove the Nyquist criterion for distortionless base band transmission. (10 Marks)

   (b) A computer gives a binary data at the rate of 56 kbps and is transmitted using a base band PAM system that is designed to have a raised cosine spectrum. Determine the transmission band width required for roll-off rates i) $\alpha = 0.25$, ii) $\alpha = 0.75$. (10 Marks)

4. (a) Explain the following with reference to digital modulation

   i) Quadri phase shift keying

   ii) Minimum shift keying

   iii) Differentjal phase shift keying. (12 Marks)

Contd.... 2

(b) Compare the average power requirements of binary non-coherant ASK, coherent PSK, DSPSK and non-coherent FSK signalling schemes operating at a data rate of 1000 bits/sec. Over a bandpass channel having a band width of 3000Hz, $\eta/2 = 10^{-10} w/Hz$, $p_e = 10^{-5}$. (8 Marks)

5. (a) Explain the function of correlation receiver. (6 Marks)

(b) Explain the following criterion of estimation of signal.

i) Minimum mean square error estimate

ii) Maximum likelyhood estimate (6 Marks)

(c) A pulse $s(t) = \begin{cases} 1, & 0 \le t \le T \\ 0 & elsewhere \end{cases}$ It is proposed to approximate a matched filter for this pulse by a low pass RC filter defined by the transfer function $H(f) = \frac{1}{1+j(\frac{f}{of})}$. Where $f_0 = \frac{1}{2\pi RC}$ is $3dBBW$.

i) Determinet he optimum value of (fo) for which the RC filter provides the best approximation to the matched filter.

ii) Assuming an additive white noise of zero mean and psd = No/2, what is the peak output signal to noise ratio?

iii) Determine the increase in the transmitted energy so as to realize the same performance as the perfectly matched filter. (8 Marks)

6. (a) Define the spread spectrum and develop a model for the base band spread spectrum system. (6 Marks)

(b) Explain the following frequency hop spread spectrum systems

i) Slow frequency hopping

ii) Fast frequency hopping (8 Marks)

(c) A slow FH/MHSK has the following parameters.

no. of bits/ MFSK symbol = 4
no. of MFSK symbols / hop = 5

Calculate the processing gain of the system. (6 Marks)

7. (a) Explain with a neat block diagram adaptive subband coding. (10 Marks)

(b) Explain the following

i) Eye-pattern

ii) Adaptive equalization (10 Marks)

8. Write short notes on the following :

a) Robust quantizaiton

b) Gram-Schmidlt orthogonalization

c) TDM

d) Inter symbol interference. (20 Marks)

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NEW SCHEME

EC61

Reg. No. | | | | | | | | | | |

Sixth Semester B.E. Degree Examination, January/February 2006

EC/TE/BM/ML

Digital Communications

Time: 3 hrs.) (Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) With neat block diagram explain the operation of digital communication system. Explain the functioning of each block. **(6 Marks)**

   (b) State and prove sampling theorem for wide sense stationary message process, whose power spectrum is strictly band limited. **(8 Marks)**

   (c) A low pass signal $x(t)$ has a spectrum $X(f)$ given by

   $$X(f) = \begin{cases} \frac{1-|f|}{200} & ; \ |f| < 200 \\ 0 & ; \ \text{elsewhere} \end{cases}$$

   i) Sketch the spectrum $X_\delta(t)$ for $|f| < 200Hz$ if $x(t)$ is ideally sampled at $f_s = 300Hz$.

   ii) Repeat part (i) for $f_s = 400Hz$. **(6 Marks)**

2. (a) With a suitable block diagram, explain the functioning of a PCM system. **(6 Marks)**

   (b) Derive an expression for maximum signal to quantization noise ratio for PCM system that employs linear quantization techniques. What will be the $S/N]_{dB}$ if the destination power and signal amplitude are normalized? **(8 Marks)**

   (c) A PCM system which employs uniform quantization and produces a binary output is given an input signal whose amplitude varies from +4 Volt to –4 Volt, and having average power of 40m. Watt. Calculate the member of bits/sample if the required signal to noise ratio is 20 dB. **(6 Marks)**

3. (a) Explain the principles of Delta modulation. With relevant figures and mathematical expressions explain the functioning of DM transmitter and receiver. **(8 Marks)**

   (b) A delta modulator is designed to operate at three times the Nyquist rate for a signal with 3 kHz bandwidth. The quantizing step size is 250 m. Volt.

   i) Determine the maximum amplitude of a 1kHz input sinusoid for which the delta modulator does not show slope overload.

   ii) Determine post filtered output SNR for the signal of part (i) **(6 Marks)**

   (c) Explain with suitable block diagram how ADPCM is used to code speech at low bit rate. **(6 Marks)**

4. (a) What is ISI? Derive an expression for Nyquist pulse shaping criteria for distortionless baseband binary transmission. **(6 Marks)**

   (b) What is correlative coding? For input binary data 1011101 obtain the output of precoder in a duobinary signalling and also the output of decoder. **(8 Marks)**

Contd.... 2

Contd.... 2

(c) For a binary sequence 111000110101 draw the digital format waveforms corresponding to

i) Polar Manchester coding waveform

ii) Bi-polar NRZ waveform

iii) 8-ary signalling waveform. (6 Marks)

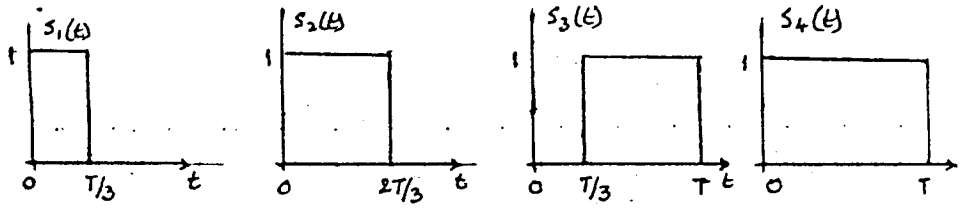
5. (a) Explain the working of a BPSK transmitter and receiver. What are the drawbacks of BPSK system? (8 Marks)

(b) Estimate the power spectral density of a BPSK signal. (4 Marks)

(c) Describe the concept of minimum shift keying. show the coded waveform for bits 00, 10, 11 and 01. (8 Marks)

6. (a) Explain the concept of maximum likelihood estimation. (6 Marks)

(b) Consider the signals $S_1(t)$, $S_2(t)$, $S_3(t)$ and $S_4(t)$ as given below



Find an orthonormal basis for these set of signals using Gram Schmidt orthogonalization procedure. (10 Marks)

(c) Briefly explain the properties of matched filter. (4 Marks)

7. (a) What is spread spectrum technique? How are they classified? (8 Marks)

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

(c) A slow FH/MESK system has the following parameters.
The number of bits/MFSK = 4 and
The number of MFSK symbol/hop =5

Calculate the processing gain of the system. (4 Marks)

8. Write short notes on the following :

(a) Aperture effect and its remedy

(b) Adaptive side band coding

(c) Correlation receivers

(d) Linear predictive vo coder (5×4=20 Marks)

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EC61

USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, July 2006

Digital Communication

Time: 3 hrs.] [Max. Marks:100

Note: *1. Answer any FIVE full questions.*

1 a. With a block diagram explain a typical digital communication system. **(06 Marks)**

b. Explain different channels used in digital communication. **(06 Marks)**

c. State and prove sampling theorem as applied to low pass signal. **(08 Marks)**

2 a. Explain the principle of quadrature sampling of band pass signals. **(06 Marks)**

b. The signal $g(t)=4\cos(4\pi t)\cos(400\pi t)$ is sampled at the rate of 500 samples/sec.
i) Determine the spectrum of the resulting sampled signal.
ii) What is the Nyquist rate for g(t)?
iii) What is the cut off frequency of ideal reconstruction filter? **(08 Marks)**

c. Three independent message sources of bandwidths 1 KHz, 1 KHz, 2 KHz respectively are to be transmitted using TDM scheme. Determine:
i) the commutator segment arrangement.
ii) the speed of commutator if each signal is sampled at its Nyquist rate.
iii) minimum transmission bandwidth. **(06 Marks)**

3 a. Obtain an expression for the signal to quantization noise power ratio in the case of PCM. Assume that the amplitude of signal is uniformly distributed. **(06 Marks)**

b. A speech signal of maximum frequency 3.4 KHz and amplitude 1 V is applied to a delta modulator whose bit rate is 20 Kbps. Determine minimum step size for the delta modulator so that there is no slope overload. **(06 Marks)**

c. With a block diagram explain an adaptive delta modulator transmitter and receiver system. **(08 Marks)**

4 a. A binary data sequence is 0110011... Sketch the waveform for the following formats:
i) NRZ unipolar ii) RZ polar iii) NRZ bipolar iv) Manchester coding.
Discuss the merits and demerits of these formats. **(08 Marks)**

b. Obtain an expression for the power spectral density of NRZ polar waveform. **(06 Marks)**

c. The binary data 001101001 are applied to the input of a duo binary system. Construct the duo binary coder output and corresponding receiver output. Assume that precoder is used. **(06 Marks)**

Contd... 2

5 a. Explain a coherent binary PSK transmitter and receiver. (06 Marks)

b. Assuming channel noise to be Additive White Gaussian, obtain an expression for probability of error. (06 Marks)

c. Explain the principle of QPSK system. Compare binary PSK and QPSK schemes. (08 Marks)

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

b. Give the properties of matched filter. (06 Marks)

c. A signal s(t) of duration Tsec is as follows :

$s(t) = +a/2$ for $0 \le t \le T/2$

$= -a/2$ for $T/2 < t \le T$.

i) Determine the impulse response of a filter matched to this signal and sketch it as a function of time.

ii) Plot matched filter output as a function of time.

iii) What is the peak value of the output? (08 Marks)

7 a. Explain the sequence of PN sequence. (06 Marks)

b. Explain the principle of direct sequence spread spectrum communication system. (08 Marks)

c. In a direct sequence spread spectrum system, a 20 – stage feedback shift register is used to generate maximum length PN sequence. What is the processing gain? (06 Marks)

8 a. Explain the principle of frequency hopping spread spectrum system. (08 Marks)

b. Mention the advantages of spread spectrum communication system. (06 Marks)

c. A slow FH/MFSK system has the following parameters:

The number of bits MFSK symbol = 4

The number of MFSK symbols per hop = 6

Calculate the processing gain of the system. (06 Marks)

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EC61

USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, Dec.06 / Jan.07
Electronics and Communication Engineering
Digital Communication

Time: 3 hrs.] [Max. Marks:100

Note: *1. Answer any FIVE full questions.*
2. Error function table to be supplied.

1 a. With a neat block diagram, describe the basic signal processing operations involved in a digital communication system. (07 Marks)

b. State and prove sampling theorem for low pass signals. (07 Marks)

c. A signal $m(t) = 10\cos 20\pi t \cos 200\pi t$ is sampled at the rate of 250 samples per second. i) Determine the spectrum of the resulting sampled signal.
ii) Specify the cut-off frequency of the ideal reconstruction filter so as to recover $m(t)$ from its sampled version.
iii) What is the Nyquist rate for the signal $m(t)$? (06 Marks)

2 a. Derive an expression for output SNR of the quantiser and show that $(SNR)_0 = 1.8 + 6R$ in decibels if a sinusoidal signal is quantised. (10 Marks)

b. With neat diagrams, explain the operation of DM transmitter and receiver. (10 Marks)

3 a. Discuss the various properties of line codes (digital formats). (07 Marks)

b. For a given binary sequence 01101001, draw the digital format waveforms corresponding to i) Uniform Manchester Code. ii) Bipolar RZ wave form.
iii) NRZ polar signaling scheme. (06 Marks)

c. Discuss the inter symbol interference problem and explain how Nyquist pulse shaping criterion is helpful in eliminating it. (07 Marks)

4 a. Discuss base band transmission of M-ary data. (06 Marks)

b. What is Eye pattern? Explain how it is helpful in understanding the ISI problem. (07 Marks)

c. Write a note on Adaptive Equalisation. (07 Marks)

5 a. How are digital modulation techniques classified? With neat block diagrams explain
i) BPSK transmitter and
ii) Coherent BPSK receiver. (12 Marks)

b. Derive an expression for the average probability of symbol error of coherent binary FSK system. (08 Marks)

6 a. State and prove properties of Matched filter. (10 Marks)

b. With the help of a block diagrams, explain the operation of QPSK transmitter and receiver. (10 Marks)

7 a. With neat diagram, explain the transmitter and receiver of slow frequency hop spread M-ary frequency shift keying system. (10 Marks)

b. Distinguish between slow frequency hopping and fast-frequency hopping. (05 Marks)

c. Explain the application of spread spectrum technique to code-division multiple access. (05 Marks)

8 Write notes on : a. TDM b. Duobinary signaling c. DPCM. (20 Marks)

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EC61

USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, June 2007
EC / TE / ML / BM
Digital Communication

Time: 3 hrs.] [Max. Marks:100

Note : *1. Answer any FIVE full questions.*
2. Make suitable assumptions wherever necessary and state them.

1 a. With a neat block diagram, explain the basic signal processing operation in digital communication. **(07 Marks)**

b. Define the sampling theorem for band pass signals with necessary diagrams. Explain the generation and reconstruction of band pass signals. **(07 Marks)**

c. The signal $g(t) = 10\text{Cos}(20\pi t)\text{Cos}(200\pi t)$ is sampled at the rate of 250 samples per second.
i) Determine the spectrum of the resulting sampled signal
ii) Specify the cutoff frequency of the ideal reconstruction filter so as to recover g(t) from its sampled version.
iii) What is the Nyquist rate for g(t)? **(06 Marks)**

2 a. With a conceptual model, define and derive an expression for signal to distortion ratio. **(08 Marks)**

b. Prove that the Shannon's channel capacity theorem can be easily achieved by increasing the average power in PCM systems by $K^2/12$. **(06 Marks)**

c. A PCM system uses a uniform quantizer followed by a 7-bit encoder. The bit rate of the system is equal to 50×10^6 bits/sec:
i) What is the maximum message bandwidth for which the system operates satisfactorily?
ii) Determine the output signal to quantization noise ratio when a full load sinusoidal modulating wave of frequency 1 MHz is applied to the input. **(06 Marks)**

3 a. With a neat block diagram explain the delta modulation transmitter and receiver. **(08 Marks)**

b. Explain Inter Symbol Interference (ISI). How it is avoided? **(05 Marks)**

c. The binary data 011100101 are applied to the input of a modified duobinary system
i) Construct the modified duobinary coder output and corresponding receiver output without a precoder.
ii) Suppose that due to error in transmission, the load produced by the third digit is reduced to zero, construct a new receiver output. **(07 Marks)**

4 a. What is an 'Eye pattern'? How is it useful in digital communication system? **(06 Marks)**

b. With a neat structure explain the concept of the adaptive equalization process. **(06 Marks)**

c. Explain the operation of Binary Frequency Shift Keying (BFSK) transmitter and receiver with necessary block diagrams. **(08 Marks)**

Contd.... 2

5 a. For the binary sequence 01101000, explain the signal space diagram for coherent QPSK system. Draw the respective waveforms. **(06 Marks)**

b. With neat block diagrams, explain the DPSK transmitter and receiver. Illustrate the generation of DPSK signal by assuming binary input sequence. **(08 Marks)**

c. A binary FSK system transmits data at a rate of 2 Mbps over a AWGN channel. The noise is zero mean with power spectral density $\frac{N_0}{2} = 10^{-20}$ W/Hz. The amplitude of received signal in the absence of noise is 1 μV. Determine the average probability of error for coherent detection of FSK. **(06 Marks)**

6 a. With a necessary illustration when N = 2, M = 3, explain the geometric interpretation of signal. **(06 Marks)**

b. In brief, discuss the properties of matched filter. **(08 Marks)**

c. The finite energy signal S(t) is as shown below in fig.6(c):

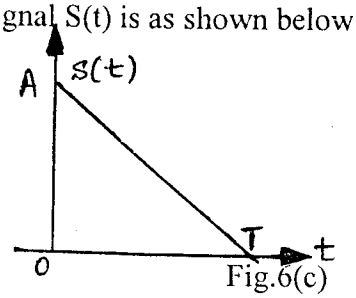

Fig.6(c)

i) Sketch the impulse response $h_{opt}(t)$ of optimum filter matched to signal S(t).

ii) Determine the value of the output signal at t = T assuming noise is zero and input is S(t). **(06 Marks)**

7 a. Explain the concept of Wiener filtering and derive an expression for minimum squared error E_{min}. **(06 Marks)**

b. Three signals $S_1(t)$, $S_2(t)$ and $S_3(t)$ are equiprobable and are given by,

$$S_1(t) = \sqrt{\frac{2}{T}}\cos\left(\frac{4\pi t}{T}\right), \qquad 0 \le t \le T$$

$$S_2(t) = \sqrt{\frac{2}{T}}\cos\left(\frac{8\pi t}{T}\right), \qquad 0 \le t \le T$$

$$S_3(t) = \sqrt{\frac{2}{T}}\cos\left(\frac{12\pi t}{T}\right), \qquad 0 \le t \le T$$

i) Sketch the signal space diagram and the decision boundaries for the signal set.

ii) Show that the signal space can be reduced to have 2 dimensions. **(08 Marks)**

c. Discuss the pseudo-noise (PN) sequence with a neat diagram showing the maximum length sequence generator. **(06 Marks)**

8 a. Explain the frequency hop spread M-ary FSK transmitter and receiver. **(08 Marks)**

b. In brief discuss the applications of spread spectrum techniques. **(08 Marks)**

c. In a direct sequence spread spectrum modulation scheme, a 14-stage linear feedback shift register is used to generate the PN code sequence.
Find: i) The period of code sequence
ii) Processing gain. **(04 Marks)**

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EC61

Sixth Semester B.E. Degree Examination, Dec. 07/Jan. 08
Digital Communication

Time: 3 hrs. Max. Marks:100

Note : *1. Answer any FIVE full questions.*
2. Assume missing data suitably.

1 a. Explain various communication channels for digital communication. (08 Marks)
b. Bring out merits and demerits of digital communication over analog communication. (04 Marks)
c. Explain quadrature sampling of band pass signals. (08 Marks)

2 a. What is flat top sampling? Derive an expression for the flat top sampled signal. (07 Marks)
b. Explain time division multiplexing (TDM). (05 Marks)
c. A signal $x(t) = 2 \cos 400\pi t + 6 \cos 640\pi t$ is ideally sampled at $f_s = 500HZ$. If the sampled signal is passed through an ideal low pass filter with cut off frequency $f_c = 400HZ$ find :
i) X(f) and sketch its spectrum.
ii) Sampled signal $X_\delta(f)$ and sketch its spectrum.
iii) The components that will appear at the filter out put. (08 Marks)

3 a. What is the necessity of non uniform quantization? Explain two compounding methods used in practice. (06 Marks)
b. With diagrams, explain in detail, the operation of DPCM transmitter and receiver. (10 Marks)
c. A telephone signal with hand width 4KHz is digitized in to an 8-bit PCM; sampled at Nyquist rate. Calculate PCM transmission band width and signal to quantization noise ratio (SNR). (04 Marks)

4 a. Explain T_1 carrier system. (06 Marks)
b. Explain, how raised cosine spectrum can be used to reduce ISI. (06 Marks)
c. A binary data sequence is 10011011. Sketch the wave form for the following formats : (04 Marks)
i) Unipolar RZ ii) Polar NRZ.
d. The output of a digital computer is at a rate of 64 kbps. Find the bandwidth required to transmit the data using a binary PAM system with a raised cosine spectrum if the roll off factors $\alpha = 1$ and 0.25. (04 Marks)

5 a. Explain Duo binary signaling schemes and obtain the transfer function of the Duo-binary filter (without precoder). (07 Marks)
b. Explain the need for a precoder in duo binary signaling. For input binary data 1011101, obtain the output of precoder, duo binary uncoder output and decoder output. (09 Marks)
c. Write a note on 'equalization'. (04 Marks)

6 a. With a diagram, explain FSK coherent detection. (07 Marks)

b. Explain :
i) Quadrature Phase shift keying ii) Differtial Phase shift keying. (08 Marks)

c. Explain M-ary modulation techniques. (05 Marks)

7 a. Show that the probability of bit error of a matched filter receiver is given by (08 Marks)

$$P_e = \frac{1}{2} \text{ erfc } \sqrt{\frac{E_b}{N_o}}$$

b. Explain maximum likely hood estimator. (06 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 1 mv.

The noise power spectral density $\frac{N_o}{2} = 10^{-15}$ Watt/Hz. Find the average probability of error if the detection is coherent. (Hint : take $\text{erfc}(5) \approx 3 \times 10^{-6}$) (06 Marks)

8 a. Define spread spectrum. Explain the principle of direct sequence spread spectrum system. (09 Marks)

b. Explain :
i) Slow frequency hopping.
ii) Fast frequency hopping. (08 Marks)

c. A slow FH/MHSK has the following parameters
Number of bits/MFSK symbol = 4
Number of MFSK symbols/hop = 5.
Find the processing gain of the system. (03 Marks)

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USN | | | | | | | | | | |

06EC61

Sixth Semester B.E. Degree Examination, June-July 2009
Digital Communication

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer any FIVE full questions, selecting at least TWO questions from each Part A and Part B.***
2. Missing data may be suitably assumed.

PART – A

1 a. Obtain an expression for Fourier Transform of a sampled signal. Assume flat top sampling. **(08 Marks)**

b. A bandpass signal g(t) with a spectrum shown below figure Q1 (b) is ideally sampled. Sketch the spectrum of sampled signals at $f_s = 25$ and 45 Hz. Indicate if and how the signal can be recovered. **(08 Marks)**

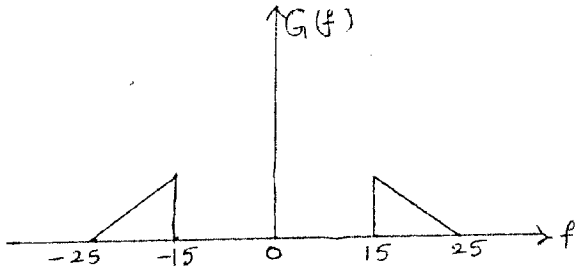

Fig. Q1 (b)

c. What is 'aperture effect'? How is it eliminated? **(04 Marks)**

2 a. Explain the need for nonuniform quantization. Also explain μ-law and A-law companding. **(08 Marks)**

b. If E denotes the energy of a strictly bandlimited signal g(t), then prove that $E = \frac{1}{2\omega}\sum_{n=-\infty}^{\infty}\left|g\left(\frac{n}{2\omega}\right)\right|^2$, where ω is the highest frequency component of g(t). **(06 Marks)**

c. The signal $g(t) = 2\cos(2000\pi t) - 4\sin(4000\pi t)$ is quantized by rounding off, using a 12-bit quantizer. What is the rms quantization error and the quantization SNR? **(06 Marks)**

3 a. Consider a speech signal with a maximum frequency of 3.4 kHz and maximum amplitude of 1 volt. The speech signal is applied to a D.M. with its bit rate at 20 kbits/sec. Discuss the choice of an appropriate stepsize for the delta modulator. **(05 Marks)**

b. Compare PCM and DPCM. **(04 Marks)**

c. Obtain power spectral density of NRZ bipolar format and draw its normalized PSD. **(11 Marks)**

4 a. Design a binary baseband PAM system to transmit data at a bit rate of 3600 bits/sec, with a bit error probability $< 10^{-4}$. The channel response is given by,

$$H_C(f) = \begin{cases} 10^{-2} & |f| < 2400 \\ 0 & \text{elsewhere} \end{cases}$$

The noise power spectral density is $G_n(f) = 10^{-14}$ watts/Hz, $Q(y) \le 10^{-4}$, $y \ge 3.75$, parameter $\beta = \frac{r_b}{6}$. **(10 Marks)**

b. A binary data sequence is 011011. Sketch the waveform for the following formats: **(04 Marks)**
i) RZ unipolar ii) NRZ Bipolar

c. With a neat structure, explain the concept of the adaptive equalization process. **(06 Marks)**

PART – B

5 a. Explain with a neat block diagram the coherent QPSK Transmitter and Receiver. **(08 Marks)**

b. A binary FSK system transmits data at a rate of 2MBPS over an AWGN channel. The noise is zero mean with PSD, $\frac{N_0}{2} = 10^{-20}\,W/Hz$. The amplitude of received signal in the absence of noise is 1 μV. Determine the average probability of error for coherent detection of FSK. Take $erfc\sqrt{6.25} = 0.00041$ **(06 Marks)**

c. Show that the energy of signal $S_i(t)$ is equal to the square of length of the corresponding vector S_i. **(06 Marks)**

6 a. What do you mean by an optimum receiver with reference to a digital modulation scheme? Write the scheme of a correlation receiver and describe its features. **(06 Marks)**

b. Find the output of the matched filter and determine the maximum value of $\frac{S}{N_0}$ if the input s(t) is a rectangular pulse of amplitude A and duration T. **(08 Marks)**

c. Calculate the bandwidth efficiency of an M-ary signaling scheme. **(06 Marks)**

7 a. Consider the set of signals,

$$S_i(t) = \begin{cases} \sqrt{\frac{2E}{T}}\cos(2\pi f_c t - i\frac{\pi}{4}) & 0 \le t \le T \\ 0 & \text{elsewhere} \end{cases}$$

where i = 0, 1, 2, 3 and f_c is an integer multiple of $\frac{1}{T}$.

i) Determine the dimensionality N of the signal set.
ii) Determine a set of orthogonality N of the signal set.
iii) Determine the coefficients S_{ij} of the signals $S_i(t)$.
iv) Give the signal constellation diagram. **(10 Marks)**

b. What is spread spectrum communication? What is its primary advantage? What are the commonly used spread spectrum technique? **(07 Marks)**

c. Write the applications of spread spectrum technique. **(03 Marks)**

8 Write short notes on:

a. Duobinary signaling.
b. Eye pattern.
c. Correlation receiver.
d. TDM. **(20 Marks)**

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06EC61

Sixth Semester BE Degree Examination, Dec.09-Jan.10
Digital Communication

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Missing data may be suitably assumed.

PART – A

1 a. Explain merits of digital communication system over analog communication system. **(04 Marks)**

b. Obtain the expression for Fourier transform of sampling function h(t) used for flat top sampling. Hence explain aperture effect with the help of spectral diagrams. Bring out the differences between aperture effect and aliasing effect. **(08 Marks)**

c. Four messages bandlimited to w, w, w and 3w are to be time division multiplexed, with w being 2000 Hz. Se up a TDM scheme for the same and find speed of the commutator in samples per second. **(08 Marks)**

2 a. A signal x(t) is uniformely distributed in the range $\pm x_{max}$. Calculate signal to noise ratio for pulse code modulation of this signal. **(08 Marks)**

b. Draw the output of midtread type uniform quantizer for one complete cycle of a sinusoidal modulating signal. **(06 Marks)**

c. A 10 KHz sinusoid with amplitude 1V peak is quantized to have SNR of about 45 dB. Find the number of bits required per sample, bit rate and bandwidth of the system if sampling frequency is twice the Nyquist rate. **(06 Marks)**

3 a. Explain DPCM with neat diagrams for transmitter and receiver and relevant mathematical equations. **(07 Marks)**

b. Derive the condition for no slope overload distortion in delta modulation system. Hence derive the expression for post filtered signal to noise ratio. **(09 Marks)**

c. Draw the output of a delta modulator for input m(t) = 0.01t when sampled with fs = 20 Hz. **(04 Marks)**

4 a. Define intersymbol interference and explain ideal solution for zero ISI. **(08 Marks)**

b. Explain modified duobinary coding with precoder. **(08 Marks)**

c. A binary PAM wave is required to be transmitted via a channel having bandwidth 75 kHz. The bit duration is 10 μsec. Find a raised cosine pulse spectrum that satisfies these requirements. **(04 Marks)**

PART – B

5 a. A binary signal transmitted using PSK has the bitrate of 100 kilobits per second. Sketch the PSK wave form for binary data 110 if carrier frequency used has frequency $f_c = 1/t_c$, where $3t_c = T_b$. **(04 Marks)**

b. Explain coherent PSK receiver. Obtain the expression for probability of error for PSK with coherent receiver. **(10 Marks)**

c. A binary data is transmitted using ASK over AWGN channel at a rate of 2.4 Mbps. The carrier amplitude at the receiver is 1mv. Noise power spectral density is $No/2 = 10^{-15}$ watts/Hz. Find the average probability of error if detector is coherent. Take erfc (5) $\cong 3 \times 10^{-6}$. **(06 Marks)**

6 a. Give the steps used for finding basis functions using orthogonalization procedure, for N = 2. **(06 Marks)**

b. Define MAP criteria in a receiver and explain how ML criterion is used in correlation receiver. **(14 Marks)**

7 a. Derive the expression for SNR for a matched filter. **(10 Marks)**

b. Explain fast frequency hop spread spectrum system. **(10 Marks)**

8 Write notes on:

a. Robust quantization **(07 Marks)**

b. TI system **(07 Marks)**

c. Notion of spread spectrum system. **(06 Marks)**

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06EC61

Sixth Semester B.E. Degree Examination, May/June 2010
Digital Communication

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With a block diagram, explain the basic signal processing operations involved in a digital communication system. **(07 Marks)**

b. Explain 'flat-top' sampling, using waveforms and equations. **(07 Marks)**

c. The signal $x(t) = 2\cos 400\pi t + 6\cos 640\pi t$ is ideally sampled at $f_s = 500$ Hz. If the sampled signal is passed through an ideal low pass filter with cut off frequency of 400 Hz:
i) Determine the spectrum of the sampled signal and sketch.
ii) What frequency components will appear in the filter output? **(06 Marks)**

2 a. Write a note on 'TDM'. **(04 Marks)**

b. Show that the signal to quantization noise power ratio of a uniform quantizer is $[SNR]_{dB} = 1.8 + 6n$ and n = number of bits/sample. **(06 Marks)**

c. What is the necessity of non uniform quantization? Explain compounding. **(06 Marks)**

d. A telephone signal band limited to 4 KHz is to be transmitted by PCM. The signal to quantization noise power ratio is to be at least 40 dB. Find the number of levels into which the signal has to be encoded. Also find the transmission band width. **(04 Marks)**

3 a. With neat diagrams, explain the operation of DPCM. **(07 Marks)**

b. A DM system is tested with a 10 KHz sinusoidal signal with 1 V peak to peak at the i/p. It is sampled at 10 times the Nyquist rate. What is the step size required to prevent slope overload? **(04 Marks)**

c. Explain T1 – carrier system. **(05 Marks)**

d. For the binary bit sequence 10110100, draw the waveforms using: **(04 Marks)**
i) Unipolar NRZ ii) Unipolar RZ iii) Polar NRZ iv) Bipolar NRZ.

4 a. Describe Nyquist's criteria for distortionless baseband transmission. **(06 Marks)**

b. Explain the need for a precoder in a duobinary signaling. For i/p binary data 1011101, obtain the o/p precoder and o/p of duobinary coder. Explain how data can be detected at the receiver. **(08 Marks)**

c. What is equalization? Explain adaptive equalization for data transmission. **(06 Marks)**

PART – B

5 a. Explain the working of:
i) Coherent BFSK transmitter and ii) QPSK transmitter. **(10 Marks)**

b. The bit stream 1011100011 is to be transmitted using DPSK technique. Determine the encoded sequence and transmitted phase sequence. Also write the block diagram of the modulator and demodulator for the same and explain. **(10 Marks)**

6 a. 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 1 μV. Noise spectral density $N_o/2$ is 10^{-15} Watt/Hz. Find the average probability of error if the detection is coherent. Take $\in rfc(5) \simeq 3\times10^{-6}$. **(06 Marks)**

b. With a diagram, explain the model of digital communication system. **(08 Marks)**

c. Explain geometric interpretation of signals. **(06 Marks)**

7 a. Explain the detection of known signals in noise. **(10 Marks)**

b. Write a note on minimum mean square error estimate. **(04 Marks)**

c. A polar NRZ waveform is to be received by a matched filter. Binary 1 is represented by a rectangular positive pulse and binary 0 is represented by a rectangular negative pulse. Find out the impulse response of the matched filter and sketch it. **(06 Marks)**

8 a. Mention the applications of spread spectrum system. Explain the principle of direct sequence spread spectrum system. **(08 Marks)**

b. Explain the frequency hopped spread spectrum system. **(08 Marks)**

c. A slow FH/MFSK system has the following parameters:
The number of bits / MFSK symbol = 04
The number of MFSK symbol / hop = 05
Calculate the processing gain of the system in decibels. **(04 Marks)**

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