35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Data Communication *(CT602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Describe the transmission impairments of data communication system with suitable example. [6]
2. Define periodic and non-periodic signals with examples. Determine whether the following signals are periodic or not.
   a) $X(t) = \sin 15\pi t$ b) $x(t) = \sin\sqrt{2}\pi t$ [2+3+3]
3. What are Recursive and Nonrecursive system? Test the stability of the CTI system whose impulse response is given as: $h(t) = e^{-t}\text{Sin}(t)u(t)$ [3+5]
4. State and explain Shannon-Hartley channel capacity theorem with example. Briefly discuss about the measures that are used to characterize the performance of a channel. [4+4]
5. a) An audio frequency signal $10\ \sin 1000\pi t$ is used for a single tone amplitude modulation with a carrier of $50\ \sin 2\pi \times 10^5 t$. Calculate :
      (i) Modulation index
      (ii) Bandwidth requirement
      (iii)Total power delivered if load = 60Ω [2×3]
   b) Encode the bit stream 10010110001 using the following encoding schemes:
      (i) Polar NRZ-L
      (ii) Polar NRZ-I
      (iii)Differential Manchester [2×3]
6. a) Explain, how spread spectrum techniques like FHSS and DSSS work? [6]
   b) Explain the operation of packet switching system. [4]
7. Considering a $\frac{1}{2}$ rate, 4-state convolutional code, correct 3 bits errors using the help of its trellis diagram. [10]
8. Explain QAM with its transmitter circuit and draw any one constellation diagram for 32-QAM. [6+2]
9. The source of information symbols {A0, A1, A2, A3 and A4} have corresponding probabilities {0.4, 0.3, 0.15, 0.1 and 0.5}. Encode the source symbols using most efficient coding scheme and calculate the corresponding efficiency. [10]

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INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
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Year / Part	III / I	Time	3 hrs.

Subject: - Data Communication *(CT602)*

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1. Draw a generic block diagram of digital communication system for full duplex mode and briefly explain the function of each block. [8]
2. Derive an expression to find even and odd part of signal x(t). Find even and odd part of a signal $x(t) = 0.5(t+1)$ for $-1 \le t \le 1$. [4+4]
3. State the properties of continuous time Fourier series. [6]
4. Define LIT system. Determine the range of values of "a" and "b" for the stability of LTI system with impulse response. $h(t) = e^{at}u(t) + e^{-bt}u(t)$ [3+5]
5. A single tone FM is represented by the voltage equation as $v(t) = 12\cos(6\times10^{8}t+5\sin1250t)$. Determine following: [8]
   a) Carrier frequency
   b) Modulating frequency
   c) Modulation index
   d) Maximum frequency deviation
6. Applying a $\frac{1}{2}$ rate, 4-state convolutional code correct errors of two bits with the help of its trellis diagram. [8]
7. What is multiplexing and why we need it? Explain FDM hierarchy in telephone system. [3+5]
8. What is CRC? Explain 3 bit CRC generator and decoder with example of no error case. [2+6]
9. Write down the Huffman Algorithm clearly. Find an efficient code word and calculate efficiency that can be assign to the symbols using Huffman Algorithm using probabilities $p(x1) = 0.5$, $p(x2) = 0.25$, $p(x3) = 0.125$, $p(x4) = 0.125$. [4+4]
10. Write short notes on: (Any two) [2×5]
    a) Means of Band width utilization
    b) Data communication impairments
    c) B8ZS

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1. Define transmission Impairment. Compare analog communication system with digital communication system with appropriate block diagram for half-duplex mode. [4+6]
2. Explain the linearity and time invariance property of a system with example. Check whether the following system is linear, time invariant and causal or not. [5+3]

   $y(t) = x(t-2) + x(2-t)$
3. Find the output of LTI system having impulse response $h(t) = e^{-2t}; t > 0$ to the input. [8]

$$x(t) = \begin{cases} 0 \text{ for } t<0 \\ 1 \text{ for } 0 \le t \le 1 \\ 0 \text{ for } 1<t \end{cases}$$

4. a) What are the advantages of optical fibers over coaxial cable and twisted pair cable? [3]
   b) State Nyquist's and Shannon's channel capacity formula. Find the Capacity of a channel for a signal with a bandwidth of 3.1 KHz and Signal to Noise ratio of O dB and comment on it. [2+3+3]
5. Encode the bit stream 1010011001 using NRZ-L, NRZ-I, RZ, Manchester, Bipolar AMI encoding technique. [2×5]
6. a) Define multiplexing with example. Compare synchronous and asynchronous TDM. [3+3]
   b) Generate a CRC-3 transmission code and analyze its error detection performance with example.
7. Explain the rate of switching and compair circuit switching with packet switching. [2+5]
8. Consider a five symbol source with probability assignment as $P(X_1) = 0.2, P(X_2) = 0.35$ $P(X_3) = 0.1, P(X_4) = 0.2, P(X_5) = 0.15$. By using Huffman algorithm, find the source code for these symbols and determine efficiency of the code. [10]
9. Describe with short notes: (any two) [2×5]
   i) HD3S coding
   ii) Packet switching
   iii) Designing a codeword of a c(6,3) block code with any suitable generation matrix

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INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Data Communication *(CT602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. Draw generic block diagram of digital communication duplex system and explain each block. Write down the advantages and disadvantages of digital communication over analog communication system. [5+3]
2. Define LTI system. Compute convolution between two signals $x(t) = e^{-at}.u(t)$ $(a > 0)$ and $h(t) = e^{at}.u(-t)(a > 0)$ and plot the resulting signal. [3+6+1]
3. Check linearity, causality, stability and time invariance characteristics of system $y(t) = 2x(t+1)$ [6]
4. Identify and discuss different data transmission channels. How synchronous transmission differs from asynchronous transmission? [4+4]
5. What is Frequency modulation (FM)? Explain with suitable equations and waveforms. [2+4]
6. Define multiplexing. Compare the merits and demerits of synchronous TDM and statistical TDM method. [2+6]
7. What is Data Switching? Clarify the differences between datagram switching and virtual packet switching. [2+6]
8. Where convolution codes are used? Describe a convolution codes with ½ rate. [2+6]
9. What do you mean by entropy? Describe linear block coding method with a suitable example for detection of an error. [2+6]
10. Explain the general working principle of Binary Huffman Coding Algorithm. Design a Binary Huffman code with a six symbol source with probability assignment as: $P(s_1)$=0.0 $P(s_2) = 0.1, P(s_3) = 0.1, P(s_4) = 0.4, P(s_5) = 0.06$ and $P(s_6) = 0.3$. [4+6]

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45 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Data Communication *(CT602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
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1. Describe the Transmission Impairments of Data Communication system with suitable examples. [6]
2. Define stable and unstable systems. Test the stability of the LTI systems whose impulse responses are given as (i) $h(t) = e^{\Psi t}u(t)$ (ii) $h(t) = e^{-\Psi t}u(t)$ [2+3+3]
3. Distinguish between energy and power signal with an example. Justify whether a signal $x(t) = e^{-a|t|}.u(t)(a > 0)$ is energy or power signal. [4+4]
4. State and explain Shannon-Hartley channel capacity theorem. Briefly discuss about the measures that are used to characterize the performance of a channel. [4+4]
5. Encode the Bit Stream 10110001110 using the following scheme. [10]
   a) RZ
   b) NRZ-I
   c) NRZ-L
   d) AMI
   e) Manchester
6. What do you mean by multiplexing? Explain about working mechanism of FDM and TDM. [2+3+3]
7. Differentiate between circuit switching and packet switching with suitable diagram. [6]
8. What are block codes? The generator matrix for a (6,3) block code is shown below. Obtain all code words. [2+8]

$$G = \left[\begin{array}{ccc:ccc} 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 \end{array}\right]$$

9. What are Hamming codes? Write the properties of Hamming codes. Visualize a 3-bit code words as code vector. [2+4+4]
10. A message source generates 8 symbols with the following probabilities: [6]

$P(X_1) = 1/2$, $P(X_2) = 1/4$, $P(X_3) = 1/8$, $P(X_4) = 1/16$, $P(X_5) = 1/32$, $P(X_6) = 1/64$

$P(X_7) = 1/128$ and $P(X_8) = 1/128$

Encode the message using Huffman code.

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$P(X_7) = 1/128$ and $P(X_8) = 1/128$

Encode the message using Huffman code.

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45 TRIBHUVAN UNIVERSITY
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Subject: - Data Communication *(CT602)*

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1. Differentiate between causal and anticausal signals with examples. Determine the power and energy for a continuous time signal of $x(t) = e^{-2t}u(t)(t \geq 0)$ [6+4]
2. Define periodic and non-periodic signals. Determine if the following systems are linear, time-invariant, stable and memoryless. [2+3+3]
   a) $y(t) = [1 - e^{-4t}][U(t)]$ where U(t) is the continuous-time unit step function
   b) $y[k] = \sin(x[k-4])$
3. Define LTI system and impulse response. For the given signal $x(t) = e^{-at}u(t)(a > 0)$, find and plot the magnitude and phase spectra. [2+2+6]
4. Briefly discuss about the measures used to characterize the performance of a channel. State Nyquist's and Shannon's channel capacity formula. [2+2]
5. Define Throughput and Latency. Explain about different types of propagation. [3+5]
6. Design (a) RZ (b) NRZ-L (c) NRZ-I (d) AMI waveforms for the data sequences of 1111000111100110. [10]
7. Define multiplexing and list out its applications. Draw block diagram of Frequency Hopping Spread Spectrum transmitter and receiver and explain briefly. [4+6]
8. Differentiate between datagram switching and virtual circuit switching technique. Discuss packet switching taking example of X.25 protocol in detail. [5+5]
9. Show the application of hamming distance with suitable example. [4]
10. Write short notes on: [3×2]
    i) Linear block coding
    ii) Huffman loading

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INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
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Year / Part	III / I	Time	3 hrs.

Subject: - Data Communication *(CT602)*

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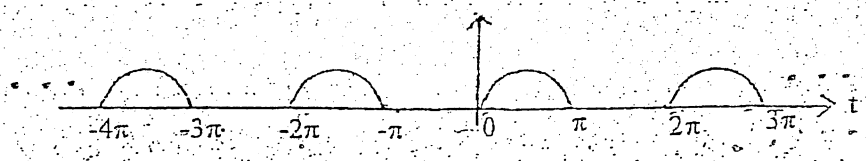
120

1. Define noise. Briefly discuss the types of noise. Define thermal noise power density; calculate the thermal noise power density in Watts/Hz at a temperature of 17°C, the Boltzmann's constant is 1.38×10^{-23} J/K. What is delay distortion and how can it be corrected? Why is digital transmission preferred over analog transmission? [4+2+2]
2. Define energy and power signal. Check the signal $x(t) = u(t)$ and $x(t) = \delta(t)$ is Energy or Power type. [1+4]
3. Define Linear, Stable, Time Invariant and Causal system with suitable examples. [4]
4. Find the Fourier series representation of the half-wave rectified Sine wave. [4]



5. Find the Fourier transform of the signal $x(t) = e^{-a|t|}$, where $(0 < a < \infty)$ is real-valued and $|t|$ denotes the absolute value of (t). Define the terms linear time-invariant (LTI) systems and impulse response. [4+2]
6. Compare the transmission characteristics and performance (frequency range, bandwidth, security, flexibility, interference, connectivity) of Optical fiber cable and Satellite transmission. [6]
7. Given a channel with an intended capacity of 40 Mbps. The bandwidth of the channel is 6 MHz. What signal-to-noise ratio is required in order to achieve this capacity? Also find number of bits/sample if channel becomes noiseless. [3+2]
8. Explain the working of Pulse Code Modulation (PCM). Draw AMI and Manchester encoding for the sequence [0 1 1 0 1 0 0 0 1]. [4+3+3]
9. Define multiplexing. Explain the working mechanism of WDM. Differentiate between synchronous and statistical TDM. How is spread spectrum utilized in CDMA? What are the advantages and disadvantages of CDMA? [2+2+2+2+2]
10. How does ATM differ from frame relay? What are the advantages and disadvantages of ATM compared to frame relay? [2+3]
11. Why is source coding necessary? Differentiate between fixed length codes and variable length codes. What is the purpose of Huffman's coding algorithm? Explain the general working principle of the Huffman coding algorithm. [1+1+1+3]
12. Define Dataword and Codeword with suitable example. List the error detection and correction coding techniques with their application case. [2+4]
13. Discuss the concept of redundancy in error detection and correction. Define Hamming distance? Differentiate between linear block codes and cyclic codes. [1+1+3]

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46 TRIBHUVAN UNIVERSITY
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1. Explain digital communication system with general block diagram. Explain the advantages of digital communication system over analog communication system. [6+2]
2. Explain the basic properties of systems with examples. [8]
3. Define unit impulse and unit step function. Obtain the Fourier transform of a single sided exponential function e^{-at}. u(t). Also draw the spectrum. [2+5+3]
4. Compare guided and unguided transmission media. Calculate the channel capacity having bandwidth and SNR of 6 kHz and 6 db respectively. [5+3]
5. Define modulation. Why is it necessary? Encode the bitstream 10101111000011 using NRZ, RZ, AMI and Manchester coding. [4+4]
6. Explain Quadrature Amplitude Modulation (QAM) with transmitter and receiver block diagram. [8]
7. What are the differences between multiplexing and multiple access? Define Time Division multiplexing (TDM) and explain it briefly. [3+5]
8. Define switching. Compare circuit and pocket switching. Draw the X.25 layers and data formats. [7]
9. Define Information, Entropy and Minimum Hamming Distance with examples. [2+2+2]
10. Define cyclic code. Explain the procedure for determining code vector for linear block code. [3+6]

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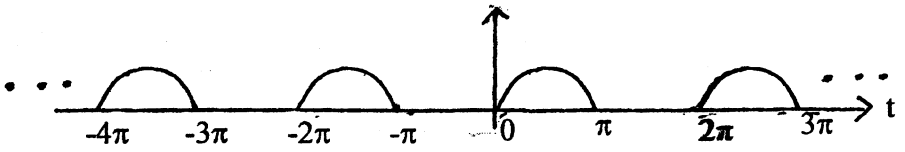

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