TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2081 Bhadra**

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

## *Subject:* - Data Communication *(CT 602)*

- ✓ 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. a) Prepare a generic block diagram of a digital communication system representing communications between an air traffic controller and an in flight pilot in a cockpit. [5]
   b) Explain the basic causes of transmission impairments in communication system. [3]
2. Define a linear system and a time invariant system. Evaluate the odd and even component of a signal defined as: $x(t) = e^{-2t}u(t)$. [2+6]
3. Considering the combinations of at least seven mathematical operations in an equation, prepare a signal flow diagram of any system. [8]
4. Compare and contrast Fourier series and Fourier transform. Mention the conditions and properties of Fourier transformation. [2+2+4]
5. a) Explain the different modes of data transmission in optical fiber. List out and mention the protocols of different categories of twisted pair cables. [3+3]
   b) A bandlimited signal with maximum frequency 4 KHz is sampled at the rate of Nyquist frequency. It is quantized into 128 levels and encoded. Calculate: Bandwidth of the channel required to transmit the data through a channel with SNR of 0 dB. [2]
6. Encode the given bit sequence 11000000000101 using any suitable two of polar and two of bipolar encoders. [2+2+2+2]
7. Prepare Code Tree, State Space and Trellis diagrams of 1/2 rate convolutional channel coding for a message bit of 1101; and demonstrate how Viterbi Decoding corrects a single bit error. [2+2+2+4]
8. Encode "SaReGaMaPaDhaNiSa" using Huffmann Encoding and calculate its transmission efficiency. What would be the code sequence if the recipient has wrongly received the message like "SaReSaRePaDhaNiSa"? [4+2+4]
9. Write short notes on: (Any Three) [3×4]
   a) CDMA
   b) Packet switching
   c) CRC-4
   d) 16-QAM
   e) E1 Hierarchy

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TRIBHUVAN UNIVERSITY
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**Examination Control Division**
**2081 Baishakh**

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***Subject:*** - Data Communication *(CT 602)*

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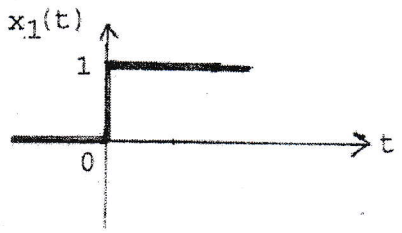
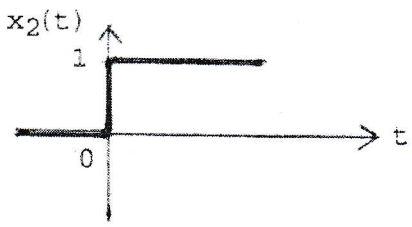
1. Explain the digital data communication system working in full duplex mode using a block diagram. Define the transmission performance parameters in a data communication system. [4+4]
2. Define energy and power signal with examples. Check whether the following system is linear, causal and time invariant or not. [4+6]

   $y(t) = \log x(t)$
3. State the properties of Fourier Transform. Convolve the following signals graphically. [2+6]




4. a) Explain the importance of Scrambling in the digital data encoding process. Encode the binary pattern 101000011101 using polar RZ, NRZ-I, AMI and Manchester line coding techniques. [2+4]

   b) Explain 16-QAM with constellation diagram. [4]
5. Compress "Ghumne Mech Mathi Andho Manche" using Huffman coding to determine efficiency redundancy and compare it with entropy. [10]
6. Write down the applications of multiplexing. Describe FHSS and DSSS with necessary diagrams. [2+4+4]
7. Explain CRC-4 generator and decoder with example for both no-error and with-error cases. [8]
8. With suitable example demonstrate how convolutional code corrects errors. [6]
9. Write short notes on: (Any Two) [2×5]

   a) Difference between circuit switching and packet switching

   b) Code division Multiple Access (CDMA)

   c) Shannon's channel capacity theorem.

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TRIBHUVAN UNIVERSITY
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**2080 Bhadra**

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## *Subject:* - Data Communication *(CT 602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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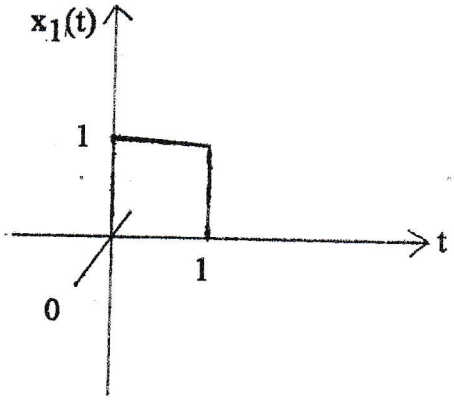
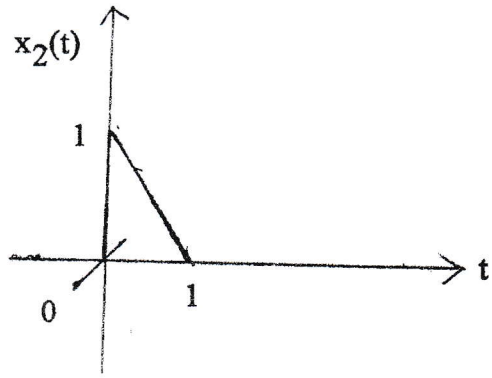
1. Define transmission performance parameters in data communication system. Explain digital communication system with appropriate generic block diagram. [4+4]
2. Define a causal system and a stable system with example . Evaluate power and energy of a signal given as $x(t) = e^{-2|t|}$ . Justify whether it is energy signal or power signal. [4+6]
3. Define LTI system. Convolve the following signals graphically. [2+6]




4. a) Explain different types of pulse modulation techniques with necessary diagrams. [6]
   b) Explain briefly about 8-QAM with constellation diagram. [4]
5. a) Determine the CDMA encoded transmitting message for four users using Walsh Hadamard codes, where user A, B, C and D are transmitting 1,0, silent, 1 respectively. [5]
   b) What is multiplexing? Why statistical TDM is prefferred than synchronous TDM? [2+3]
6. Define Hamming distance and Minimum hamming distance with an example. What are the error detection and error correction capabilities of block codes? Explain. [2+4]
7. Obtain all code words for a (6, 3) block code from the systematic generator matrix given below. [8]

$$G = \begin{bmatrix} 1 & 0 & 0{:}1 & 1 & 1 \\ 0 & 1 & 0{:}1 & 1 & 0 \\ 0 & 0 & 0{:}1 & 0 & 1 \end{bmatrix}$$

8. Using a suitable example, explain state, tree and trellis diagrams for ½ code rate and 4 states. [10]
9. Write short notes on : (Any Two) [2×5]
   a) Datagram packet switching vs Virtual circuit packet switching
   b) E1 and T1 Hierarchies
   c) Modes of operation of optical fiber

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TRIBHUVAN UNIVERSITY
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***Subject:*** - Data Communication *(CT 602)*

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1. Define data and signal. Elaborate the advantages of digital communication system as compared to analog communications system. Explain the basic causes of transmission impairments in communication system. [2+2+4]
2. a) Determine whether or not the following CT signal is periodic. If the signal is periodic, determine its fundamental period. $x(t) = 3\cos(4t+\pi/3)$. [2]
   b) Test the linearity of the systems, $y(t) = x^2(t)$ and $y(t) = 3x(t) + 5$ [4]
   c) Test the systems static or dynamic, $y(t) = 2x(t)$ and $y(t) = 2x(t) - 3x(t-3)$ [4]
3. a) Find the output response of an LTI system when input $x(t) = e^{-t}\,u(t)$ and impulse response $h(t) = e^{-2t}\,u(t)$. [4]
   b) Find magnitude and phase spectrum of $x(t) = 4 + 2\cos\frac{2\pi}{3}t + 4\sin\frac{5\pi}{3}t$. [4]
   c) Discuss any four properties of Fourier Transform. [2]
4. Compare coaxial cable with optical fibre. Evaluate the maximum capacity of a channel through which a signal with power of 10 dBW is transmitted. (Assume that the noise power spectral density is given as 5 m W/Hz). [4+4]
5. a) Consider AM signal as $m(t) = 5[1+2\cos(2\pi + 1000t)]\cos(2\pi * 10^8 t)$. Determine modulation index, total power delivered. [4]
   b) Define PCM technique used to convert analog signal into digital data. In a PCM system, a bandlimited signal with maximum frequency 4 kHz is sampled at the rate of Nyquist frequency. It is quantized into 256 levels and encoded. Calculate: [2+4]
      (i) Minimum data rate avilable at the output of the encoder.
      (ii) Bandwdth of the channel required to transmit the data through a channel of 15 dB SNR.
   c) What are the basic factors to be considered while line coding? Encode the binary pattern 100000000100001 using B8ZS and HDB3 encoding. [2+4]
6. Explain the major bandwidth utilization techniques used in data communication. Explain Frequency Hopped Multiple Access (FHMA) technique using its transmitter and receiver blocks. [4+6]
7. Differentiate between circuit switching and Packet switching used in computer networks with an example. [6]
8. a) Explain error detection and correction mechanism with trellis diagram. [10]
   b) Differentiate convolutional code and block code. [2]

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TRIBHUVAN UNIVERSITY
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**2079 Bhadra**

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

***Subject:*** - Data Communication *(CT 602)*

- ✓ 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. Define Data and Signal with examples. Sketch a generic block diagram of digital data communication system for full duplex mode. [2+6]
2. Define a causal system and a stable system. Check whether a system $y(t) = x(t) + x(t-1)$ is (i) linear (ii) time-invariant (iii) causal (iv) memoryless system [2+6]
3. State properties of continuous time Fourier Transform. [4]
4. Find convolution between two signals $x1(t) = u(t) - u(t-3)$ and $x2(t) = u(t+4) - u(t)$. [4]
5. State and explain theorem for noisy and noiseless channel. Briefly discuss about the measures that are used to characterize the performance of channel. [4+4]
6. a) Why we need modulation? A modulating signal, $m(t) = 10\cos(2\pi \times 10^3 t)$ is amplitude modulated with carrier signal, $c(t) = 50\cos(2\pi \times 10^5 t)$. Find the modulation index, the carrier power and the power required for transmitting AM wave. [2+6]
   b) Encode the bit stream 101110001010 using NRZ-L, NRZ-I, Manchester, Bipolar AMI. [4×2]
7. a) Discuss briefly on Spread Spectrum communication with neat block diagram. [4]
   b) What are the two basic approaches commonly used to packet switching? [4]
   c) Compare all three types of multiplying technique with the application case of each. [8]
8. a) Apply the Huffman coding procedure to determine Entropy, Average Code length, code efficiency and Redundancy for the following message ensemble $[x] = [x1, x2, x3, x4, x5, x6]$ and $[p] = [0.30, 0.25, 0.15, 0.12, 0.08, 0.10]$, Take $M = 2$ [8]
   b) For a (6, 3) code, the generator matrix is

$$G = \begin{matrix} 1\,0\,0\,1\,0\,1 \\ 0\,1\,0\,0\,1\,1 \\ 0\,0\,1\,1\,1\,0 \end{matrix}$$

   Find (i) All corresponding code vectors (ii) Minimum Hamming distance (iii) Verify that this code is a single error correcting code (iv) Parity check matrix (v) Determine transmitted codeword if received code is 100011. [8]

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TRIBHUVAN UNIVERSITY
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**2078 Bhadra**

| Exam. | Regular | | |
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| Level | BE | Full Marks | 80 |
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## *Subject:* - Data Communication *(CT 602)*

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1. Differentiate between energy and power signals with examples. Determine if the following system is stable LTI. [5+5]
   $Y(t) = x(t^2)$
2. List and describe all data communication parameters that describe the performance of the system. [8]
3. Explain how we plot line spectrums of a continious time signal and illustrate an example. [8]
4. Encode 111000000000000011 using B8ZS and HDB3 encoders. [10]
5. Demonostrate how checksum is used to detect errors while sending a data word of 12, 15, 15, 10, 5, 2. [8]
6. a) Explain the working principle of FHSS technique. [5]
   b) Explain how CDMA works with example. [5]
7. What are linear block codes? Design a code word of a C(8, 4) block code with any suitable generation matrix. [8]
8. Encode "Jasta lai tastai dhido lai nistai" using weighted Huffman encoder. Also demonstrate how it is decoded. [10]
9. Describe with short notes on: (Any Two) [2×4]
   a) Double-tone AM
   b) Hamming codes
   c) Packet switching versus message switching
   d) X.25 protocol

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TRIBHUVAN UNIVERSITY
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**Examination Control Division**
**2078 Kartik**

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

## *Subject:* - Data Communication *(CT 602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. a) Differentiate data and signal with two examples of each. [5]
   b) Explain the procedure of converting an analog signal to digital. Also, briefly explain each steps involved. [5]
2. Define periodic and non-periodic signals with examples. [2+4+4]
   a) Test the stability of the system $h(t) = e^{4t}.u(t)$
   b) Test the given function $y(t) = t.x(t)$ for causality, non causality and anti causality.
3. How Nyquist theorem applied for a noiseless channel? Calculate number of discrete signal content in the channel if a channel has a spectrum of 3 to 4 MHz with signal to noise ratio of 24 dB. [5+5]
4. Explain the operation of CRC-4 with example of error detection. [10]
5. Define line coding. Explain polar RZ and bipolar AMI line coding scheme with example and compare them. [4+3+3]
6. a) How is source coding different from channel coding? [2]
   b) Under what conditions does a linear code become a cyclic code? Explain with the help of an example. [3]
   c) Explain the concept of convolutional code with the help of a state-transition diagram. [5]
7. Write down the Huffman Algorithm clearly and find an efficient code word and efficiency that can be assign to the symbols using Huffman Algorithm for "Kun Mandir Ma Janchhau Yattri". [10]
8. a) Explain the mechanism of frequency Hopping spread spectrum (FHSS). Also, compare FDM and FHSS using suitable time-frequency graph. [4+3]
   b) Explain the "near-far problem" in CDMA. How can it be solved? [2+1]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
# Examination Control Division
**2076 Chaitra**

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

## *Subject:* - Data Communication *(CT 602)*

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1. Draw a generic block diagram of a digital communication system used in mobile telephony and explain each block. Compare analog and digital communication system with examples. [6+2]
2. Explain the properties of causal, non-causal and anticausal systems with example. [10]
3. Explain why we need Fourier Transform. Plot the line spectrums of $X(t) = 12 + 6\sin(140\pi t + 30°) - 9\cos(80\pi t - 70°)$. [5+5]
4. Why we need Modulation? Illustrate an example of a 4-bit PCM with AMI encodes. [2+6]
5. Demonostrate how CRC-5 works to detect errors in data communication. [8]
6. What is multiplexing? Compare synchronous and statistical TDM. Describe Frequency hopping spread spectrum and direct sequence spread spectrum with its block diagram. [2+4+4]
7. Construct a (7, 4) Hamming code using a 4×4 generation matrix for any arbritery message. [8]
8. Encode "Phool ko aankhama phoolai sansara" using Huffman encoder and find the transmission efficiency. [10]
9. Write short notes on: (Any two) [4×2]
   a) STP versus UTP
   b) Frame relay
   c) 16-Quadrature amplitude modulation
   d) Multi mode optical fiver

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TRIBHUVAN UNIVERSITY
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**2076 Ashwin**

| Exam. | Back | | |
|---|---|---|---|
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***Subject:*** - Data Communication *(CT 602)*

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1. Enlist the advantages and disadvantages of digital communication system over analog communication system. Discuss the transmission impairments of data communication system with suitable diagrams and suggest the methods in overcoming attenuation. [3+5]
2. What are properties Fourier transform? Plot the magnitude and phase spectra of $X(t) = 5 + \sin(12t + 20^\circ) - \cos(16t - 60^\circ) + \cos(20t + 40^\circ)$. [4+4]
3. Sketch the output of LTI system having impulse response $h(t) = e^{-at}u(t)$ (a>0) and $h(t) = e^{at}u(-t)$ (a>0). [10]
4. List different types of digital-to-analog line encoding techniques. Give an example of QAM-32 in its constelletion diagram. [2+6]
5. Explain with example how CRC-5 work to detect 3 burst errors. [10]
6. Define Frequency division Multiplexing. Explain the FDM Multiplexing and demultiplexing process with neat diagrams. [8]
7. Design a suitable generation matrix for a convolution code using c(3,1,3) architecture and encode input data stream of (00110). [10]
8. Design a Binary Shannon-Fano code with a six symbol source with probability assignment as $P(s_1)=0.04$, $P(s_2)=0.1$, $P(s_3)=0.1$, $P(s_4)=0.4$, $P(s_5)=0.06$, $P(s_6)=0.3$. Test its transmission efficiency. [7+3]
9. Write short notes on: ***(Any Two)*** [4×2]
   a) Analog versus digital mux hierarchy
   b) DSSSH versus FSSH
   c) Optical fiber versus STP

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
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**2075 Chaitra**

| Exam. | Regular / Back | | |
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## *Subject*: - Data Communication *(CT 602)*

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1. Sketch a generic block diagram of digital data communication system for full duplex mode. [8]
2. Distinguish between power and energy signals with examples. [8]
3. State the condition for the stability of LTI system. Test the stability of the system whose impulse response is $h(t)=te^{-3t}u(t)$ [8]
4. List digital- to-digital line encoding techniques and explain in detail Bipolar 8-zero substitution and High Density 3-zero substitution techniques. [2+4+4]
5. With suitable mathematical expression, explain double-tone AM technique. [8]
6. Demonstrate how CRC-4 works to trace two burst errors. [10]
7. Differentiate between digital and analog spread spectrum techniques using examples. [8]
8. Define entropy in information theory. Find the efficient code word and efficiency using Hoffman algorithm using probabilities $p(x1)=0.6$, $p(x2)=0.2$, $p(x3)=0.1$, $p(x4)=0.05$, $p(x5)=0.05$. [8]
9. Explain why channel coding is required in data communication. Generate a convolution code for a input bit streams of (111011) using a c(3,1,3) architecture. [2+10]

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**2075 Ashwin**

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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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**Examination Control Division**
**2074 Chaitra**

| Exam. | Regular | | |
|---|---|---|---|
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## *Subject:* - Data Communication *(CT602)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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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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INSTITUTE OF ENGINEERING
**Examination Control Division**
**2074 Ashwin**

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

***Subject:*** - Data Communication *(CT602)*

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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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46 TRIBHUVAN UNIVERSITY
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.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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]

0.04

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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**.*
- ✓ *Assume suitable data if necessary.*

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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45 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2072 Chaitra**

| Exam. | Regular | | |
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## *Subject:* - Data Communication *(CT602)*

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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
INSTITUTE OF ENGINEERING
**Examination Control Division**
2072 Kartik

| 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.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

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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45. TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2071 Chaitra

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

***Subject:*** - Data Communication *(CT602)*

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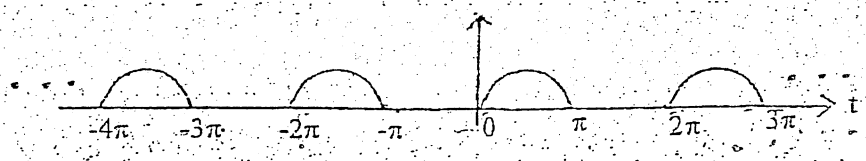
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

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 $1.38\times10^{-23}$ 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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INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
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*Subject:* - Data Communication *(CT602)*

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- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

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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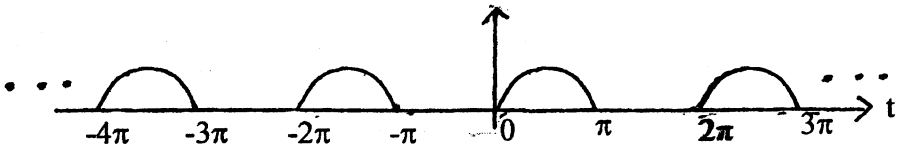


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