

DATA COMMUNICATION

CT 602

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : III
Part : I

Course Objective:

To familiarize student with the concept of data communication, communication signals and their characteristics, transmission media and their characteristics, basics of multiplexing and switching

1. Introduction [4 hours]

- 1.1 Data and Signal
- 1.2 Analog and Digital Signal
- 1.3 Data Representation
- 1.4 Analog and Digital Data Communication System
- 1.5 Transmission Impairments (Attenuation, Noise, Distortion)

2. Signals and Systems [4 hours]

- 2.1 Signal and Classification of Signals: Periodic and Non-periodic Signals, Deterministic and Random Signals, Energy and Power Signals, Continuous Time and Discrete Time Signals
- 2.2 System and Basic Properties of Systems: System with and without memory, Linearity, Time Invariance, Invertibility, Casuality, Stability

3. Signal Analysis [6 hours]

- 3.1 Unit Impulse Function and Unit Step Function
- 3.2 LTI System and Impulse Response
- 3.3 Fourier Series Representation of Continuous Time Signal
- 3.4 Fourier Transform of Continuous Time Signal
- 3.5 Spectral Analysis of a Signal, Signal Bandwidth

4. Transmission Media [4 hours]

- 4.1 Electromagnetic Spectrum for Communication and Type of Propagation
- 4.2 Guided Transmission Media: Copper Media (Twisted pair and Co-axial) and Fiber Optics
- 4.3 Unguided Communication Bands and Antennas
- 4.4 Unguided Transmission Media: Terrestrial Microwaves, Satellite Communication and Cellular System
- 4.5 Data Rate Limits: Nyquist Bit Rate for Noiseless Channel, Shannon Capacity for Noisy Channel
- 4.6 Performance of Channel: Bandwidth, Throughput, Latency, Jitter, Bit Error Rate (BER)

5. Data Encoding and Modulation [10 hours]

- 5.1 Baseband Communication (Analog/Digital)
- 5.2 Data Encoding and Modulation
- 5.3 Types of Analog Modulation: Amplitude Modulation, Frequency Modulation and Phase Modulation
- 5.4 Pulse Modulation System: Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM)
- 5.5 Encoding Analog Data as Digital Signal: Pulse Code Modulation (PCM)
- 5.6 Encoding Digital Data as Digital Signals
- 5.7 Line Coding Schemes: NRZ, RZ, Manchester, AMI
- 5.8 Block Coding, Scrambling
- 5.9 Digital Modulation: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Quadrature Amplitude Modulation (QAM)

6. Multiplexing and Spreading [6 hours]

- 6.1 Multiplexing and Application
- 6.2 Frequency Division Multiplexing (FDM), Wavelength-Division Multiplexing (WDM)
- 6.3 Time Division Multiplexing (TDM)
- 6.4 Spread Spectrum
- 6.5 Code-Division Multiple Access (CDMA)

7. Switching [3 hours]

- 7.1 Switching and Application
- 7.2 Circuit Switching and Packet Switching
- 7.3 Datagram Switching and Virtual Circuit Switching
- 7.4 X.25, Frame Relay, ATM

8. Information Theory and Coding [8 hours]

- 8.1 Introduction to Information Theory, Average Information
- 8.2 Source Coding – Huffman Coding
- 8.3 Error Detection and Correction Codes
- 8.4 Hamming Distance
- 8.5 Linear Block Coding
- 8.6 Cyclic Codes, CRC
- 8.7 Convolution Codes

Practical:

- 1. Signal analysis using MATLAB
- 2. Bandwidth analysis of different signals using spectrum analyzer
- 3. Analog Modulation Generation and Reconstruction
- 4. Pulse Modulation Generation and Reconstruction
- 5. Conversion of given binary sequence into different line coding
- 6. Digital Modulation (ASK, FSK, PSK) Generation and Reconstruction

References:

1. William Stallings, "Data and Computer Communications"
2. Behrouz A Forouzan, "Data Communications and Networking"
3. A. V. Oppenheim, "Signals and Systems"
4. A. S. Tanenbaum, "Computer Networks"